SECTION 01060 – REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The architects and engineers for all construction projects are responsible for identifying and preparing the documentation necessary for all permits and reviews by governmental authorities having jurisdiction over design of projects at the University of New Hampshire. The following list is a description of review processes required on recent projects undertaken by the University. It is not intended to be exhaustive, but is provided to assist in the identification of the potential permits and reviews to be undertaken for a specific project. Architects and engineers should become familiar with the regulations for each of these reviews and permits.

B. TOWN OF DURHAM

1. Water and Sewer Connection Permit/Fee.
2. In agreement with the Town of Durham, the University is subject to a water and sewer connection fee for all new buildings, additions to existing buildings, and changes in water consumption.
3. NOTE: The University of New Hampshire, as a part of the University System of New Hampshire, does not come under the jurisdiction of any local governmental authorities. Therefore local regulations such as zoning and building permits do not apply to projects at the University except as noted above. Any questions or potential issues that the architects or engineers have regarding the University's status should be addressed directly to the office of Facilities Design & Construction.

1.2 NEW HAMPSHIRE STATE REVIEWS AND PERMITS

A. Committee on Architectural Barrier-Free Design.

2. This committee reviews each publicly funded project for compliance with the Architectural Barrier Free Design Code for the State of New Hampshire. A submittal for review consists of a complete set of Design Development drawings and any potential conflicts with the Code or requests for waivers. The drawings should include mounting heights of all fixtures, controls and accessories. The committee meets on a monthly basis to review requests for waivers. If necessary, the Accessibility Specialist can be contacted for clarifications or interpretations of the Code (Tel 603-271-2773). See ADA Accessibility Guidelines for Buildings and Facilities – Appendix A to Part 36 – Standards for Accessible Design, Federal Register/Vol.56, No.144/Rules and Regulations.

1. The Durham Fire Department acts as the agent for the State Fire Marshall's office in meetings and the review of design and construction documents throughout a project. Typically, we have a preliminary meeting with the fire department and submit schematic, design development and construction documents for their review and approval. Other meetings are held as requires. Additional copies of schematic, design development and construction bid document are sent directly to the State Fire Marshal by the Architect or Engineer. The SFMO is also responsible for issuing the Certificate of Occupancy (CO) for completed Projects. The Durham Fire Department works as the Agent of the State for routine and scheduled inspections of the work in progress, including Fire Alarm System Sign off.

C. New Hampshire Bureau of Food Protection - New Hampshire Rules for the Sanitary Production and Distribution of Food (He-P2300) and BOCA Compliance.

1. The Bureau of Food Protection reviews and approves all designs and construction of public food service facilities. A submittal for review consists of a complete set of Design Development drawings with a cover letter summarizing the scope of the project. Once construction is underway a field inspector will review the work. If necessary, the Plan Reviewers can be contacted for clarification or interpretations of the Code. (Tel 603-271-4589).

D. New Hampshire DOE Status of State Energy Codes

1. Compliance with the NH Energy code is required for all University Projects.

E. Water Supply and Pollution Control Commission.

1. Water Supply Permit and Water Use Registration - RSA 148.25, 148-B.

   a. The water system for the University is provided through the University/Durham water system. A water supply permit is required for any extension of or improvement to an existing water main. A water use registration is required for projects with daily water demands projected in excess of 20,000 gallons per day.

2. Sewer Discharge Permit - RAS 485-A:4, 485.8-V.

   a. A sewer discharge permit is required for any new connection to the public sewer system that exceeds 5000 gallons per day of domestic discharge. The permit application consists of filing a State form through the Town with copies to the State. The Town must sign off and forward the application to the State WSPCC Design Review Branch. The time for State review is typically 1 to 3 weeks.

3. Industrial Discharge Permit - RSA 485.
a. An industrial discharge permit is required for discharges receiving pretreatment or discharges containing pollutants resulting from any process of industry, manufacturing, trade or business, or from development of any natural resources. The permit application consists of filing a State Discharge Permit Request Application and Approval: form through the Town with copies to the State. The Town must sign off and forward the application to the State WSPCC Design Review Branch. The time for State review is typically 2 to 6 weeks.


a. A site specific permit is required when any activity that alters or disturbs more than 100,000 sf of land is anticipated. The permit application consists of filing a "Site Specific Application" form, a project narrative, hydrology calculations, soil erosion and sediment control plans and construction level drawings (design development drawings are usually acceptable). In addition review and approval is required from the Natural Heritage Inventory at the New Hampshire Department of Resources and Economic Development (RAS 217-A:7). A locus map and a portion of the project narrative from the Site Specific Application must be submitted to NHI and approval received before WSPCC will begin review of the full application. These processes can proceed concurrently with any wetlands review and permit application.


a. A permit from the Wetlands Board is required when construction activities will occur within any wetlands boundaries. Depending on the significance of the wetlands and the disturbance to it, a public hearing must be filed with the Durham Town Clerk and the State Wetlands Board. Abutters must be notified by the proponent. The Town Conservation Commission will review the submittal and forward their comments on to the State Wetlands Board. The total time for review should be 6 to 8 weeks, if no public hearing is required.

1.3 FEDERAL REGULATORY REVIEWS AND PERMITS

A. Environmental Protection Agency:

1. NPDES Stormwater Permit. Construction Storm Water Management Plan-EPA is required for all UNH projects. Plan shall remain on public display throughout the project.

a. EPA NPDES General Permit.

2. A NPDES Stormwater permit is required for construction projects disturbing five or more acres of land. The purpose of this permit is to assure that accurate measures are taken to control soil erosion and sedimentation during construction. A general NPDES permit has been issued by the EPA authorizing
all such activities providing that a Notice of Intent is filed with the EPA prior to the commencement of construction and further provided that all construction activity complies with the conditions of the general permit.

a. Resource information is available at the University of New Hampshire Storm Water web site: http://www.unh.edu/erg/cstev/.

B. Department of the Army:

1. Department of Army Permit.

   a. Section 404 of the Federal Water Pollution Control Act.

2. A permit is required by the Army Corps of Engineers for any discharge of fill material into wetlands on a site. The permit application is filed with the State Wetlands Board in the form of the State application to the Board (see Wetlands Board Permit above). A water quality certification is required as a prerequisite to the Army permit (the application for the Wetlands Board permit initiates the water quality certification review process). The Wetlands Board will coordinate the Army Corps of Engineers to determine if additional application materials are required. Without additional materials the review is concurrent with the Wetlands Board process, with additional materials the review can take as long as 6 to 9 months.

PART 2 - MATERIALS  (Not Used)

PART 3 - EXECUTION  (Not Used)

END OF SECTION 01060
SECTION 01100 – GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following:

1. Special conditions LEED version 3.0, Silver Certification requirements or alternative owner approved equivalent certification process
2. General responsibilities of the contractor.
3. Regulations.
4. Temporary facilities and controls.
5. Quality requirements.
7. Project record documents.
8. Operation and maintenance data.
10. Demonstration and training.
11. Final cleaning.
12. Certificates and testing reports.
13. Certificate of Occupancy-Issued by the NH State Fire Marshal’s office.

B. General Requirements are intended to complement the University System of New Hampshire General Conditions of the Contract for Construction (ref. Specification Section 00700), hereinafter referred to as General Conditions and/or General Conditions of the Contract. They are not intended to replace or otherwise supersede the General Conditions. Rather, in the event of a conflict or contradiction between these General Requirements and the General Conditions, the General Conditions shall take precedence.

C. The General Conditions, Supplemental Conditions, and Division 1 Specifications of the Contract shall apply to each and every contract and contractor or other person or persons supplying labor, material, equipment and/or services entering into this Project and/or on the premises directly or indirectly.

D. Work Included in the Contract: Providing all labor, materials, equipment, and services, etc., as required to complete all Work identified in or otherwise required by the Contract Documents.

E. Work Excluded from the Contract: Work noted as "Not in Contract" (N.I.C.) or “By Owner”. However, the Contractor shall provide services and coordination related to items not in the Contract as required by the Contract Documents.

1.2 SPECIAL CONDITIONS

A. All new Construction and Renovations on the University of New Hampshire Campus are to achieve the equivalent of LEED version 3.0, Silver Certification or owner approved.
1.3 GENERAL RESPONSIBILITIES OF THE CONTRACTOR

A. Use of Local and Campus Roads: Existing roads, lanes, and required emergency access shall remain accessible at all times. At times when the Work interferes with the normal flow of traffic (including vehicles, bicycles, and pedestrians), both on and off the site, the Contractor shall coordinate with and comply with the requirements of the local and university police, highway, and public works departments including but not limited to the provision of adequate personnel, flagmen, and equipment to properly regulate traffic. Roadways and driveways shall be kept free of debris resulting from construction-related traffic. Where the Work results in the accumulation of dirt, dust, debris, etc. on local roads or in adjacent drainage channels or structures, the Contractor shall remedy said condition immediately and shall continue to do so in a manner, duration, and frequency appropriate to the condition and acceptable to the Owner and the authority having jurisdiction. Hauling permits and route approvals shall be obtained from governing authorities as applicable.

B. Campus Access: All construction-related vehicles shall approach the campus from the west (i.e. Route 4 to Route 155A/Main Street to College Road).

C. Site Access: Access to the site for workers and the delivery or removal of construction materials and/or equipment shall be coordinated in advance with the PM and all appropriate University Departments. The site access plan shall be crafted and signed by all appropriate parties and posted on site.

D. Contractor shall be responsible for providing Police details for all deliveries which may impact pedestrian or vehicular traffic or safety.

E. Use of the Site: The Contractor shall have use of the site as indicated elsewhere in the Contract Documents. Stockpiling of all materials shall be coordinated with the Owner.

F. Use of the Existing Building: The Contractor shall maintain the existing building in a weather tight condition throughout the construction period and shall immediately repair to its pre-construction condition or better any damage caused by construction operations. Furthermore, the Contractor shall limit storage of on-site materials to locations acceptable to the Owner and governing authorities.

G. Work Hours: The normal working hours for this contract shall be from 7 a.m. to 5 p.m., Monday through Friday, unless otherwise authorized by Owner. Such authorization will not be unreasonably withheld. Work shall not occur during Graduation and others days determined and agreed upon by the Contractor and the Project Manager.

H. Transportation and Permits: Contractor is responsible for providing transportation of all workers from the remote Contractors Lot to the job site. Parking permits are the responsibility of the Contractor and subcontractors to obtain from UNH Transportation Services.

I. Noise: Noise that is unnecessary or not construction-related (e.g. boom boxes, excessive hollering) are not allowed. Workers shall not wear personal audio systems.

J. Demolition waste and construction generated waste; the contractor shall be responsible for knowing and complying with regulatory requirements. Demolition and construction
generated waste shall be recycled. Refrigerants shall be recovered in accordance with EPA regulations and guidelines. Documentation of refrigerant recovery shall occur on UNH provided forms for each refrigerant. A waste management plan shall be established, and waste reduction progress reports shall be issued concurrent with each application for payment. Burning on site of waste is prohibited. All waste not recycled shall be transported off Owner’s site and legally disposed of. Provide documentation of disposal for each load removed. Waste materials are not to accumulate on site and all waste waiting transport shall be managed in a manner that will prevent spillage on adjacent surfaces and areas.

K. Superintendent/Supervision: The Contractor shall place and maintain a competent, experienced construction superintendent in charge of the Work. Except as may be approved by the Owner for periods of minor or minimal activity, this superintendent shall be on the job site at all times while work is in progress, including overtime operations by the Contractor’s forces or by subcontractors. No changes in this position shall be made without the Owner’s prior approval. The Owner shall have the right to review the qualifications of the proposed superintendent and ask for a replacement if, in the Owner’s opinion, the person proposed does not meet the qualifications that the project will demand. The same superintendent who was in charge during the general progress of the Work shall oversee the completion of all punch list items.

L. Coordination: Except as specifically indicated otherwise, the Contractor shall be fully responsible for coordinating all construction activities, verifying dimensions and existing field conditions, establishing on-site lines of authority and communication, monitoring schedules and progress, monitoring quality and ensuring quality workmanship, maintaining records and reports and assuring the proper administration of the Work. Disruptions and inconveniences to the activities of existing facilities to remain in operation during construction shall be minimized, and shall be subject to the prior approval of the Owner.

M. Job Meetings: The Contractor shall conduct regular job meetings once every week during the construction period, at such time and place as is mutually acceptable to the Owner, Project Architect, and Contractor. All major subcontractors shall be represented at each meeting as needed. Other trades or subcontractors may be called to particular job meetings, as the progress of the Work requires. The Project Architect shall record and distribute the minutes of each meeting.

N. Utilities and Roadways: Except as indicated otherwise, existing facilities, systems, and roadways shall remain in operation throughout the execution of the Work of this Contract. The Contractor shall schedule and coordinate the Work with the Owner and local police, highway, and public works departments as required to maintain the safe and functional use of such facilities, systems, and roadways. The Contractor shall send proper notices, make all necessary arrangements, and perform all other services required for the removal or the protection and maintenance of all existing utilities and services, assuming all responsibility and paying all costs related thereto. Existing utilities and services shall not be disrupted without the prior approval, and then only to the minimum extent required. The Owner reserves the right to require the Contractor to implement temporary measures/services rather than allowing a disruption of service, especially with regard to water and sewer, where applicable.
1. Tracer Wire: Bury directly on top of every substrate utility pipe that does not run clearly from Point A to Point B (i.e. sewer manhole to sewer manhole) or any other system that cannot be easily clamped onto after installation (i.e. domestic water, heating and cooling components, sewer force mains, plastic piping). Wire shall run to the surface through system valves, at building entrances, or at tracer boxes installed throughout the lines’ route. Protocol shall follow the EcoLine™ methods of installing tracer wire and boxes.

O. The Contractor, through the Owner’s Representative, shall comply with the "Underground Utility Damage Prevention System" by notification to DIG SAFE SYSTEM of intent to excavate or otherwise disturb the ground surface. The Contractor shall notify the Owner’s Representative at least five days in advance of starting any such work. The Contractor shall continually maintain associated markings. Failing that, the Contractor shall provide the services of a utility locating company for remarking efforts.


P. Means and Methods: Except as specifically indicated otherwise, the Contractor shall be fully responsible for all means, methods, procedures, sequences and techniques of construction employed toward the completion of the Work.

Q. Site Safety:

1. The Contractor shall comply with all applicable OSHA standards.
2. The Contractor shall comply with all “hot work” and “confined space” safety standards and permit procedures required by the UNH Office of Environmental Health and Safety.
3. The Contractor shall take all measures required to ensure the safety of construction workers, as well as the safety of the campus community and the public. The Contractor shall make safety a top priority and ensure that all necessary barricades and fencing are provided and that they comply with applicable regulations and standards of good practice.
4. The construction site is near existing occupied buildings and roadways. Therefore, site safety is of the utmost importance. The Contractor shall pay all costs necessary for temporary partitioning, barricading, fencing, walks, ramps, enclosures, security and safety devices required for the maintenance of a clean and safe construction site.
5. The Contractor shall prepare and manage and Emergency Response Plan which includes a comprehensive contact list. Plan shall be distributed to UNH PM and all appropriate departments across the campus.

R. Fire Protection: The Contractor shall provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and shall comply with all reasonable recommendations regarding fire protection made by the representatives of the fire insurance company carrying insurance on the Work or by governing fire or building authorities. Flammable products shall be properly stored in containers acceptable to fire officials. The area within the site limits shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site. A "Hot Work" permit shall be obtained through the Owner’s Representative for all work.
involving any type of flame or spark producing torch, saw, etc. At all times of “Hot Work”, the Contractor shall provide a dedicated “firewatch” person, who shall have no other responsibilities and whom the Contractor shall provide with appropriate fire protection and extinguishing equipment and training.

S. Protection of Adjoining Property: The Contractor shall restrict construction operations and provide all shoring, fencing, and other work necessary to support, protect and keep unharmed all walls, footings, floors, roofs, walks, roadways and all other parts of any existing buildings, facilities, site improvements, land forms, trees and plant materials, etc. outside the limits of the Work or otherwise shown to remain. The Contractor shall hold the Owner and Architect harmless from any such damage due to any operations under this Contract. Any existing work or property damaged or disrupted as a result of this Contract shall be replaced or repaired to match original existing conditions at no additional cost to the Owner.

T. Building Security: The Contractor will be issued one copy of the key(s) needed to access the applicable work area(s), which must be returned upon completion of the Work. It shall be the Contractor’s responsibility to, ensure upon leaving the project site at any time, that all doors into areas within the Contractor’s control are locked and properly latched and that all other doors that may be used by the Contractor are properly latched.

U. Vandalism: The Contractor shall take all reasonable precautions necessary to prevent loss or damage caused by vandalism, theft, burglary, pilferage, or unexplained disappearance of property of the Owner, whether or not forming part of the Work, located within those areas of the Project to which the Contractor has access.

V. Hazardous Substances: The Architect's Scope of Services and responsibilities exclude the investigation, discovery, detection, identification, presence, leakage, release, use, handling, disposal, encapsulation, abatement, treatment, or removal of, or exposure of a person or persons to hazardous materials, pollutants, contaminants, or disease transmitting organisms, pre-existing or otherwise deposited in any form at the project, indoors or outdoors, at any time before, during or after construction, including but not limited to volatile organic compounds, petroleum products, bacteria, molds, fungus, asbestos or asbestos products, lead, radon, electro-magnetic frequency radiation or other radiation. Should any such substances be encountered, the Owner and Architect shall be promptly notified, in writing.

W. Miscellaneous:

1. Smoking/Chewing: Smoking of any nature and chewing of tobacco or similar products is prohibited in and within twenty feet of all University buildings. The Contractor shall strictly enforce this prohibition and shall remove repeat offenders from the project site.

2. Alcohol and Illicit Drugs: The possession or consumption of alcoholic beverages and or illicit drugs on University property and in University buildings is prohibited. The Contractor shall strictly enforce this prohibition and shall immediately remove offenders from the project site.

3. Sexual Harassment/Lewdness: Lewdness and other forms of sexual harassment including, but not limited to, catcalls, vulgar sounds or actions, and the display of prurient images will not be tolerated, especially when directed toward or
observable by a member or members of the campus community or the public. The Contractor shall strictly enforce this policy and shall immediately remove offenders from the project.

1.4 REGULATIONS

A. General: The Contractor shall fully comply with all governing Local, State and Federal Laws, Codes, Rules, Regulations and Ordinances, including but not limited to The Americans with Disabilities Act, Equal Employment Opportunity and Affirmative Action provisions, and Occupational Safety and Health Administration provisions.

B. State Building Codes and Permits and Inspections: The University of New Hampshire, as a part of the University System of New Hampshire, falls under the jurisdiction of the New Hampshire statewide building code. (see: http://www.nh.gov/safety/boardsandcommissions/bldgcode/nhstatebldgcode.html) The Contractor shall comply therewith and shall cooperate with the Owner and with NH authorities having jurisdiction (and/or their agents) with regard to necessary reviews, testing and inspections. Normally, such construction phase reviews, testing and inspections include review of contractor submittals for sprinkler and fire alarm systems; observation of sprinkler flow, emergency lighting, and fire alarm testing; fireproofing verification; elevator, plumbing, electrical, and health inspections; as well as certificate of occupancy permitting and inspection(s). Plumbing Permit to be secured by Contractor. All inspection costs for plumbing and elevator permits and inspections shall be the responsibility of the Contractor.

C. Local Building Codes and Permits: In general, the University of New Hampshire does not fall under local jurisdiction. However, the University is subject to local water/sewer connection permitting requirements, road cut/closure permitting requirements, and noise ordinances. Therefore, the Contractor shall comply with local water and sewer connection details and installation requirements; apply and pay for all road cut/closure permits; provide and pay for all required bond premiums and police/traffic details; comply with all associated excavation, backfill, patching, and safety requirements, etc.; and comply with local noise ordinances. Environmental Regulations: The Contractor shall comply with all applicable environmental laws and regulations. Particular attention shall be paid to proper erosion, sedimentation, and dust control.

D. Parking: Parking shall be subject to University parking regulations, enforcement and procedures. The Contractor shall coordinate with UNH Parking Services relative to contractor parking permits/fees and the availability of contractor parking. It shall be understood by the Contractor that parking for all contractor and subcontractor vehicles may not be available immediately adjacent to the Project Site and that the Contractor may be directed to park some, most, or even all such vehicles remotely. Transferable contractor parking permits are available from UNH Parking Services.

E. Refer to Chapter 5, Division 1, Section 01060 for additional information.

1.5 MEASUREMENT AND PAYMENT
A. Schedule of Values: Prior to submittal of the first Application for Payment, the Contractor shall submit a schedule of values in accordance with the General Conditions.

B. Payment Requisition: The Contractor shall submit on or about the first day of each month three original copies of AIA Form G702 "Application and Certificate for Payment" with attached AIA Form G703 “Continuation Sheet.” Each copy shall be fully completed, properly executed and sealed, and delivered to the Project Architect. In order to expedite processing and payment of the Contractor’s requisitions, it is recommended that, five (5) days prior to submittal of the formal requisition, the Contractor submit electronically or via FAX one draft copy thereof to the Project Architect and Owner for advance review.

C. Release of Lien: The Contractor shall furnish current Lien Waivers for itself and from all subcontractors and material suppliers with each Application for Payment.

1.6 SUBMITTAL PROCEDURES

A. Owner Review: With the delivery of any and all submittals to the Project Architect, the Contractor shall deliver two additional copies/sets thereof to the Owner for concurrent review. All Owner comments will be forwarded to the Architect for consideration and incorporation, as appropriate, into a consolidated submittal response.

B. Identification: Each and every submittal shall be identified with a cover sheet inclusive of the following:

1. Unique submittal identifier referencing respective specification section and paragraph and including revision number. For example, Submittal # 16190-2.1.E.2-Rev.0 would identify the initial submittal for fire and smoke seals used at electrical penetrations, as specified in Spec. Section 16190, Paragraph 2.1.E.2.
2. Date.
3. Project name.
4. Name and address of Architect, Contractor, applicable subcontractor, supplier, and manufacturer.
5. A space approximately 4 by 5 inches to record Contractor’s review and approval markings and action taken by Architect.
6. Drawing number and detail references, as appropriate.
7. Contractor’s certification stating that information submitted complies with requirements of the Contract Documents.
8. Identification of deviations from requirements of the Contract Documents, including minor variations and limitations and, for resubmittals, identification of revisions other than those requested by Architect on previous submittals.
9. Other necessary or otherwise appropriate identification.

C. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
D. Comprehensive Construction Schedule: The Work of all trades shall be scheduled so that close coordination will be effected throughout all phases of construction. In accordance with the General Conditions, the Contractor shall prepare a comprehensive "Critical Path" construction schedule for his own use and the Owner's information. The schedule shall be submitted to the Architect and Owner within ten (10) days after award of Contract. The Architect's and/or Owner's receipt and review of this schedule shall in no way be construed to be approval or endorsement thereof. The Schedule shall show concisely the manner in which the Work will be prosecuted and shall specifically identify the start and completion dates of any work or activity that may disrupt or otherwise affect ongoing activities within or about the Project site.

1. If for any reason the progress schedule should fall behind schedule by ten (10) days or more the Contractor shall prepare a new progress schedule, which shall be changed to indicate the manner in which the Contractor will complete the project within the time allowed for construction.
2. The term "Day", where used throughout the Contract unless otherwise stated, shall mean "Calendar Day."

E. Submittal Schedule: Prepare a detailed schedule identifying all submittals required by the Contract Documents. Submittal schedule shall be organized chronologically to correspond to the sequence of construction and shall be coordinated with the Contractor's construction schedule and Schedule of Values. For each submittal, schedule shall list the scheduled date for initial submittal, applicable specification section/paragraph, description of the Work covered, name of respective subcontractor, supplier and/or manufacturer, scheduled date to allow for resubmittal if necessary, scheduled date for the final release/approval, and actual submittal and review dates. Update and submit the submittal schedule at least monthly and more frequently if submittal activity warrants. Final and approved submittals shall be turned over to the University in Hard Copy and electronic copy in pdf format.

F. Materials Delivery Schedule: Accompanying the Comprehensive Construction Schedule, the Contractor shall submit a materials delivery schedule with which the Comprehensive Construction Schedule has been coordinated. The materials delivery schedule shall identify all materials required for the work that are not readily available from local suppliers and/or that have long lead times and shall indicate when such materials will be delivered and whether said delivery is contingent upon a specific submittal review timetable.

G. Testing and Inspections Schedule and Coordination: Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule with the Contractor's construction schedule. The schedule shall be in tabular form and shall include, without limitation, the following: spec section number and name; description of the test; applicable standards; test methods; quantity and/or frequency of tests/samples; time requirements; entity responsible for performing tests; requirements for taking samples; and any unique characteristics of each service. The University shall hire the third party testing agency and the contractor shall coordinate in conjunction with the University PM all testing in the field.
1. The above ceiling systems will be conducted by the University after above ceiling systems have been completed and verified by the Designer. The following guidelines shall apply to this inspection: All above ceiling systems will be completed including, but not limited to, controls, insulation, labeling of systems, wiring, light fixtures, diffusers, ductwork, piping, fire proofing and sealing of wall penetrations through fire walls.

   a. Framing for hard ceiling will be completed and access door locations will be framed to assure accessibility to control valves, equipment requiring maintenance, etc. Ceiling grid will be in place and equipment will be placed in the grid.
   b. No ceilings will be covered up until this inspection is complete by the owner. Contractor shall give the Designer and the University two weeks notice to assure owner personnel are available for the inspection.

2. Fire Protection Systems:

   a. The installation contractor shall conduct a 100% performance test, which shall be ensured by the designer/engineer. When test is complete and deficiencies are corrected, the contractor shall perform a 100% retest with the University and the Durham Fire Department present. Three days prior to the final testing for acceptance the contractor shall furnish the completed NFPA Record of Completion with all printouts.

H. Shop Drawings, Cuts and Literature Submittals:

1. Submittal Requirements:

   a. In addition to the above-referenced concurrent review copies submitted to the Owner, the Contractor shall submit for review by the Project Architect a minimum of six (6) sets of manufacturer’s literature/product data, shop/coordination drawings, samples, certifications, design calculations, test reports, etc. relative to all materials and/or equipment items, fixture items, etc. proposed for incorporation into the Work. (Note that, of these, only three (3) reviewed sets will be returned to the Contractor, as described below. If the Contractor requires additional reviewed sets, the Contractor shall increase the original quantity submitted accordingly.)

   b. If so requested by the Architect for any shop drawings larger than 11”x17,” furnish three (3) prints and one (1) reproducible transparency in lieu of eight (6) prints. The reproducible transparency will be returned to the Contractor for copying and distribution, as described below.

   c. Submittals that are facsimile (FAX) produced, or are photocopies of faxed documents will not be considered or reviewed.

   d. The Contractor shall check and correct submittals for compliance with the Contract Documents before submitting them to the Architect for review. Submittals shall be marked to show which products and options are applicable and annotated with the Contractor’s corrections, field dimensions, etc. Deviations from the Contract Documents shall be clearly identified. The Contractor shall sign and stamp all submittals prior to delivery to the Architect. The submittal stamp shall state that the Contractor has reviewed the submittals and that the work shown is in
accordance with the Contract requirements and has been checked for
dimension, quantity, and relationship with work of all trades involved.
Submittals will be returned to the Contractor without review if it is apparent
that the Contractor has failed to properly review and/or stamp them prior to
submittal.

e. Completeness of Submittals: All shop drawings, brochures, cuts and
manufacturer’s literature relative to each material/item/product proposed for
incorporation into the Work shall be compiled into a single submittal
package. This applies also to resubmittals. That is, resubmittals shall
include all documentation included in the initial submission, except as
required to bring the submittal into compliance with contract requirements
and/or to be responsive to the Architect’s prior review comments.
Piecemeal or incomplete submittals and partial resubmittals will not be
reviewed.

f. The Contractor shall coordinate preparation and processing of submittals
with performance of construction activities. Coordinate each submittal with
fabrication, purchasing, testing, delivery, other submittals, and related
activities that require sequential activity. Coordinate transmittal of different
types of submittals for related parts of the Work so processing will not be
delayed because of need to review submittals concurrently for
coordination. Architect reserves the right to withhold action on a submittal
requiring coordination with other submittals until related submittals are
received.

2. Architect’s Review:

a. In general, the Architect will strive to complete his/her review of
submittals/resubmittals and return them to the Contractor within two (2)
weeks following receipt thereof. Additional time may be required if large
volumes of submittals are simultaneously delivered to the Architect for
review.

b. Review of submittals by the Architect shall not relieve the Contractor of
responsibility for compliance with the Contract Documents (unless
specifically proposed as a Substitution in accordance with the General
Conditions) and relative to verification of measurements and existing
conditions, trade coordination, etc.

c. Among other limitations, the Architect’s review shall not include the
calculation, coordination or verification of dimensions or quantities, all of
which is the sole responsibility of the Contractor.

3. Distribution:

a. Following review of submittals, the Architect will forward one (2) copies of
the reviewed submittal to the Owner, one (1) to the respective
subconsultant, and keep one (1).

b. The three (2) remaining reviewed copies will be returned to the Contractor,
who shall maintain one (1) for record submission at project closeout and
duplicate (if necessary) and distribute the others, as appropriate, to
manufacturers, subcontractors, suppliers, fabricators, installers, authorities
having jurisdiction, the Contractor’s home and field offices, and others as necessary for performance of construction activities.

c. Returned submittals stamped “revise and resubmit” or “rejected” shall not be sent to the Project Site.

4. Submittal Requirements for Environmental Impact and LEED:
   a. For Environmental Impact and LEED compliance, minimally include the information on the Manufacturer Certification for LEED Credit form attached to Chapter 5, Division 1, Section 01352 – Attachment C, based on LEED 3.0 Version 9.

5. Electronic Files: Following the receipt of a written request from the Contractor, the Architect will furnish electronic files for architectural, structural, mechanical and/or electrical drawings. As a prerequisite for the release of electronic files, the following disclaimer must be included in said written request:
   a. “The file recipient agrees to accept computer CDs/DVDs and electronic files without any warranties, guarantees and/or representations of any nature whatsoever regarding the correctness, accuracy and/or completeness of any information contained therein. The recipient acknowledges that the use of any such diskettes and electronic files is entirely at its own risk with respect to any claims, costs, losses, damages and/or liabilities arising out of or relating to the use, misuse, modification, interpretation, misinterpretation and/or misrepresentation of any such information.”

I. Test Reports: Prepare and submit certified written reports that include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Ambient conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.
   14. Follow up report for each item identified during the process which failed/and or required additional followup work with date of completion and reinspection.

J. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar
documents, established for compliance with standards and regulations bearing on performance of the Work.

K. Daily Reports: Prepare a daily construction report recording the following information concerning events at the site, at a minimum. Submit one copy each to the Architect and the Owner at weekly intervals:

1. List of subcontractors at the site and number of workers on-site for each.
2. List of separate contractors at the site.
3. High and low temperatures, general weather conditions.
4. Meetings and significant decisions.
5. Accidents, emergencies and other unusual events.
7. Orders and requests of governing authorities.
8. Services connected, disconnected.
9. Meter readings and similar recordings.
10. Equipment or system tests and startups.
11. Partial completions, occupancies.
12. Material deliveries.
13. Items identified that require corrective work and items on which corrective work was performed.

1.7 QUALITY REQUIREMENTS

A. Owner Testing: The Owner shall employ an independent testing laboratory for the purpose of testing and inspecting portions of the Work in progress. These services will be paid for by the Owner.

1. The inspection, sampling and testing provided by the Owner shall include, but may not be limited to:
   a. Soil Compaction.
   b. Soils Sieve Analysis.
   c. Waterline Disinfection.
   d. Bituminous Pavement.
   e. Cast-in Place Concrete.
   f. Precast Concrete.
   g. Piles.
   h. Structural Steel.

2. The Employment of a testing laboratory shall in no way relieve the Contractor of its obligation to perform all Work in accordance with Contract requirements.
3. All inspection, sampling and testing shall be completed prior to the commencement of any work that would alter or cover work to be inspected.

B. Contractor’s Responsibilities relative to Owner-provided testing:

1. Schedule and coordinate all testing and inspections through the Owner’s Representative. Testing and inspections shall be performed as required by
CHAPTEE 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
GENERAL REQUIREMENTS

applicable Specifications and as otherwise agreed upon by the Contractor and Architect.

2. Cooperate with testing personnel and provide access to the Work.

3. Provide representative samples of materials to be tested, in required quantities.

4. Furnish casual labor and facilities:
   a. To provide access to Work to be tested.
   b. To obtain and handle samples at the site.
   c. To facilitate inspections and tests.

5. Notify Owner’s Representative sufficiently in advance of operations (48 hours minimum) to allow for the proper assignment of personnel and scheduling of tests.

6. Relative to waterline disinfection testing, the Contractor shall be responsible for the installation and subsequent removal and plugging of all necessary flushing and sampling ports and the performance of all waterline flushing and chlorinating necessary for sampled water to comply with applicable health and safety standards.

C. Contractor Testing and Inspection Responsibilities:

1. The Contractor shall provide inspections, sampling and testing required for determining the suitability of materials prior to delivery to the site (such as analysis of off-site borrow, mortar, grout, and concrete mix designs, etc.).

2. The Contractor shall provide all specified testing and inspections, unless indicated above as being provided by the Owner. Such testing includes but may not be limited to leakage testing of underground utilities and structures, pressure/leakage testing of all piping and duct systems, electrical testing, start-up and operational testing, etc. All such testing and inspections shall be witnessed by the Owner’s Representative. Accordingly, the Contractor shall coordinate with and provide timely notice to the Owner’s Representative.

3. All Contractor-provided testing and inspections shall be performed by appropriately qualified and certified testing agencies. Formal typed reports shall be prepared for all testing and inspections performed. Copies of all such reports shall be provided in duplicate to both the Owner and the Project Architect within seven (7) calendar days of the performance of the testing/inspection or as otherwise required, whichever is more stringent.

D. Conflicting Requirements:

1. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

2. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numerical values are minimum or maximum, as
appropriate, for the context of requirements. Refer uncertainties to Owner for a decision before proceeding.

1.8 TEMPORARY FACILITIES AND CONTROLS

A. Construction Equipment: The Contractor shall furnish and maintain all equipment as required for the proper execution of the Work, unless specifically included under the Work of other trades.

1. All such apparatus, equipment, and construction shall meet all requirements of applicable laws, regulations, and standards of safety and good practice.
2. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the Work shall be furnished, installed, operated and maintained in safe condition by the Contractor.

B. Utilities: The Contractor may use on-premises utilities and services without charge for any consumption thereof, except with regard to long distance telephone charges.

C. Construction Office Trailer and Associated Equipment: Upon commencement of the project, the Contractor shall provide and maintain throughout the life of the project a separate and secure, heated and air-conditioned field office (GE single-820, or Owner-approved equal) dedicated for use by the Owner, Project Architect, and Owner-hired testing/inspection personnel. In addition to the standard built-in plan table and desk, the office trailer shall be furnished with one desk, two new desk chairs; two 4-drawer lockable file cabinets (one letter size, one legal size) with appropriately-sized pendaflex racks in all drawers; two spare folding chairs; two cantilever style plan racks with print clamps; ten knob-adjustable white hard-hats; two high-low outdoor type thermometers with reset capability; hot and cold potable water dispenser, with integral or separate refrigerator, supplied with water and cups throughout the life of the project; one broom and dust pan; two trash cans; interior lighting; electrical outlets throughout; multi-function office machine with all necessary supplies and service throughout the life of the project; and telephone and broadband internet services (including installation/removal and recurring charges). Of the above items, the hard hats, and thermometers shall become the property of the Owner upon delivery, and shall remain the property of the Owner following completion of the project.

D. Toilets: The Contractor shall provide and maintain in a sanitary condition enclosed weather tight chemical toilets for the use of all construction personnel at locations acceptable to the Owner and governing authorities. Installation of toilets shall be in accordance with all applicable codes and regulations. The number of toilets required shall be in accordance with USA Standard Safety Code for Building Construction or other local requirements, except that there shall be at least two. Maintenance of the toilets shall occur twice weekly, or more frequently if needed to maintain sanitary conditions.

E. Clean-Up: The Contractor shall at all times keep the site and structures or facilities thereon, free from accumulations of waste materials, debris, or rubbish. Upon the completion of each workday, the Contractor shall remove all tools, surplus materials, debris, and shall leave the Work "broom clean" or its equivalent.
F. Shipping and Storage of Materials: The Contractor shall be responsible for the proper protection from damage, theft and loss of all materials and equipment prior to and following the incorporation thereof into the Work.

1. Materials and equipment shall be inspected by the Contractor and if found to be damaged or otherwise unsuitable shall be promptly replaced.
2. Deliveries of materials and/or equipment to the site shall be scheduled so as not to allow the storage of materials or equipment on the site for more than ten (10) days prior to their incorporation into the Work, without prior written approval of the Architect.
3. The Contractor shall exercise caution in temporarily loading materials on floors, decks, roofs, etc. It shall be the Contractor's responsibility to determine the size of loads to be imposed and the adequacy of the affected structure to support such loads. The Contractor shall correct, at no additional cost to the Owner, any resultant damages.

G. Clean-Up: The Contractor shall at all times keep the site and structures or facilities thereon, free from accumulations of waste materials, debris, or rubbish. Upon the completion of each workday, the Contractor shall remove all tools, surplus materials, debris, and shall leave the Work "broom clean" or its equivalent. All trash and rubbish shall be removed and legally disposed of off-site, by the Contractor and at the Contractor's expense.

1. No rubbish shall be allowed to accumulate or be allowed to remain on the premises or job site beyond three (3) days. Trash (glass, paper and plastic waste etc.) shall be removed daily.
2. Care shall be taken by all workers not to mark, soil or otherwise deface finishes. In the event that any finishes become defaced in any way, the Contractor shall clean and restore such surfaces to their original condition, or replace them if so required by the Architect.

1.9 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to project Record Documents for Owner's and Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

   a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings.

4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation “PROJECT RECORD DRAWING” in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project’s Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer’s written instructions for installation.

3. Note related Change Orders, Record Drawings where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

F. Refer to Chapter 5, Division 1, Section 01770 for additional information.

1.10 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance Documentation Directory

1. Organization: Include a section in the directory for each of the following:
a. List of documents.
b. List of systems.
c. List of equipments.
d. Table of Contents.

2. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

3. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

4. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

5. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, “Preparation of Operating and Maintenance Documentation for Building Systems.”

B. Requirements for Emergency, Operation, and Maintenance Manuals

1. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

   a. Title page.
   b. Table of contents.

2. Title Page: Include the following information:

   a. Subject matter included in manual.
   b. Name and address of Project.
   c. Name and address of Owner.
   d. Date of submittal.
   e. Name and contact information for Contractor.
   f. Name and contact information for Construction Manager.
   g. Name and contact information for Architect.
   h. Name and contact information for Commissioning Agent.
   i. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
   j. Cross-reference to related systems in other operation and maintenance manuals.

3. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
a. If operation and maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

4. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

C. Operation and Maintenance Manuals: Assemble three complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:
   a. Emergency instructions and procedures.
   b. System, subsystem, and equipment descriptions, including operating standards.
   c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
   d. Description of controls and sequence of operations.
   e. Piping diagrams.

2. Maintenance Data:
   a. Manufacturer's information, including list of spare parts.
   b. Name, address, and telephone number of supplier and installer.
   c. Maintenance procedures.
   d. Maintenance and service schedules for preventive and routine maintenance.
   e. Maintenance record forms.
   f. Sources of spare parts and maintenance materials.
   g. Copies of maintenance service agreements.
   h. Copies of warranties and bonds.

3. Organize operation and maintenance manuals into suitable sets of manageable size and in an orderly sequence based on the table of contents of the Project Manual. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders in thickness necessary to accommodate contents, with clear overlay for front and spine inserts, and with pockets inside the covers to receive folded oversized sheets. Identify each binder on front and spine with inserts printed with "OPERATION AND MAINTENANCE MANUAL," project name, and subject matter of contents. Include in each volume a general table of contents for the entire set and a detailed table of contents for the individual volume. Provide tabs indexed to the table of contents for the individual volume.

D. Refer to Chapter 5, Division 1, Section 01770 for additional information.

1.11 WARRANTIES
A. Guarantees and Warranties:

1. In accordance with the General Conditions, the Contractor shall guarantee the entire Work to be free from defective or improper work or materials, and shall make good any damage due to such work or materials for a term of one year from the date of the satisfactory completion and acceptance of the Work.

2. The commencement date for warranties and guarantees shall be established as indicated in the General Conditions. In addition, under no circumstances shall any warranty or guarantee for any individual or collective materials or items of equipment be established based upon shipment or delivery dates.

3. Extended guarantees or warranties shall be provided as specified elsewhere.


   a. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, with clear overlay for front and spine inserts, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper. Identify binder on front and spine with inserts printed with "GUARANTEES AND WARRANTIES," project name, and Contractor's name and contact information.

   b. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

   c. Provide additional copies of each warranty to include in operation and maintenance manuals.

   d. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

B. Refer to Chapter 5, Division 1, Section 01770 for additional information.

1.12 DEMONSTRATION AND TRAINING

A. Demonstration and Owner-Training: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

3. Schedule training with Owner with at least seven days’ advance notice.

4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

5. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

   a. System design and operational philosophy.
b. Review of documentation.
c. Operations.
d. Adjustments.
e. Troubleshooting.
f. Maintenance.
g. Repair.

1.13 FINAL CLEANING

A. Final Cleaning: Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions. Complete the following cleaning operations, as applicable depending on Project scope, before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
4. Remove tools, construction equipment, machinery, and surplus material from Project site.
5. Remove snow and ice to provide safe access to building.
6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
8. Sweep concrete floors broom clean in unoccupied spaces.
9. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
10. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
11. Remove labels that are not permanent.
12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
13. Clean and ensure full legibility of "UL" and similar labels, including mechanical and electrical nameplates.
14. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
15. Replace parts subject to unusual operating conditions.
16. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
18. Clean ducts, blowers, and coils if units were operated without filters during construction.
19. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
20. Leave Project clean and ready for occupancy.
21. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.
22. Construction Waste Disposal: Comply with waste disposal requirements in Chapter 5, Division 1, Section 01524.

1.14 CERTIFICATES AND INSPECTION REPORTS

A. Prior to final inspection and final payment the contractor shall furnish and provide all necessary inspections and operating certificates required for each system and for the building in general. Certificates and inspection reports, along with engineer affidavits and architect's letter of substantial completion shall be bound in three loose leaf binders for presentation to the Authority Having Jurisdiction (AHJ) and the University prior to final walkthrough for the Certificate of Occupancy (CO).

B. Certificate of Occupancy.

1. Contractor is responsible for coordinating all inspections and final walkthrough for Certificate of Occupancy with the New Hampshire State Fire Marshal's Office.

END OF SECTION 01100

ATTACHMENTS:

Attachment A: Dig Safe – Utility Damage Prevention Program
ATTACHMENT A - DIG SAFE – UTILITY DAMAGE PREVENTION PROGRAM

1. **PURPOSE**: To establish policy to comply with Dig Safe - New Hampshire State Law for Utility Damage Prevention program.

2. **SCOPE**: Applies to all excavating activities.

3. **BACKGROUND**: Compliance with State of New Hampshire Law RSA 374, DIG SAFE LAW, and the New Hampshire Code of Administrative Rules, Chapter Puc 800, UNDERGROUND UTILITY DAMAGE PREVENTION PROGRAM, the University of New Hampshire is required to file notice when activities requiring “excavating” are within 100 feet of an “underground facility.”

   “Excavating” as defined by RSA 374: 48, Part III
   
   "Excavate," “excavating,” or “excavation” means any operation conducted on private property or in a public way, right-of-way, easement, public street, or other public place, in which earth, rock, or other material in the ground is moved, removed, or otherwise displaced by means of any tools, equipment, or explosive, and includes but is not limited to drilling, grading, boring, milling, trenching, tunneling, scraping, tree and root removal, cable or pipe plowing, fence or sign post installation, tent stake installation, pile driving, wrecking, razing, rendering or moving any structure or mass material but does not include the tilling of soil for agricultural purposes, landscaping and maintenance of residential property performed with non-mechanized equipment, landscaping activities performed with mechanized equipment that are intended to cut vegetation, including lawn edging, aeration, and de-thatching, excavations permitted or grandfathered under RSA 155-E, or replacement of department-of-transportation-installed delineator posts in the same location.

   “Underground facility” as defined by RSA 374:48, Part VII
   
   …any property which is buried, placed below ground, or submerged on a public way, private property, right-of-way, easement, public street, or other public place and is being used or will be used for the conveyance of cable television, electricity, gas, sewerage, steam, telecommunications, or water.

   The notice of intent is to be filed with Dig Safe Inc. – Damage Prevention System (RSA 374:49). Dig Safe Inc. receives notice of proposed excavations (here after referred to as Dig Safe request) and alerts it member utilities. Dig Safe requests require 3 business days (or 72 hours not including weekends and holidays) for processing; allowing opportunity for the member utilities to locate and identify utilities within an area of excavation.

   Violations of RSA 374 can result in substantial fines by the Utilities Commission, as well as injunctions.

4. **POLICY AND PRACTICE**:
   A. Activities associated with UNH Dig Safe will be coordinated by Energy and Campus Development – Geographic Information Systems Division (ECD-GIS).
      1) Develop Dig Safe request submittal procedure.
      2) Ensure UNH Dig Safe policy and procedures are being followed by UNH personnel as well as outside contractors on UNH property.
3) File Dig Safe notification (original notification and renewal) with Dig Safe Inc.
4) Locate and identify subsurface facilities as defined above.
5) Conduct annual UNH Dig Safe refresher seminars.

B. Any excavation activity, as defined above, will be required to submit a Dig Safe request with ECD-GIS.

C. Dig Safe requests are to be submitted to ECD-GIS by UNH personnel only. Requests from contractors will not be processed.
   1) Dig Safe requests from EMCOR are to be submitted by Energy and Campus Development Utilities Division.
   2) Individuals placed in Facilities Operations & Maintenance management and supervisory positions such as Zone Manager or Director of Operations & Maintenance through management agreements are included as the equivalent of UNH personnel and may submit Dig Safe requests

D. Area of excavation must be identified on site and referred to as “premarking.”
   1) Premarking should be completed prior to submitting a Dig Safe request.
   2) Only white marking products (paint, flags, stakes, whiskers, or combination) are to be used. Fluorescent pink may be used to premark snowy terrain.
   3) Premarking will encompass the entire site perimeter.
      a) 1-inch wide solid line, or
      b) 1-inch wide, 6 to 12-inch long dashed line at an interval of 4 to 20-feet apart, or
      c) Point features (flags, stakes, or whiskers) at interval distances that will be obvious to utility locators.

E. Dig Safe requests will not be processed without a work-order number.
   1) It is the responsibility of the requestor to obtain the work-order number.

F. Dig Safe requests are to be submitted utilizing current Dig Safe request forms.
   1) DigSafe_Request_vX.X.pdf – Typical Dig Safe Request
   2) DigSafe_Request_Renewal_vX.X.pdf – Renew a Dig Safe Ticket.
   3) Dig Safe_Request_Blasting_vX.X.pdf – Activities associated with blasting. This form is in addition to the DigSafe_Request_vX.X.pdf
   4) DigSafe_Request_Emergency_vX.X.pdf – For emergency Dig Safe requests.

G. Dig Safe requests are to be submitted with a site location map that clearly depicts area of excavation.

H. Dig Safe requests, and site map, should be scanned (PDF file type) and submitted to ECD-GIS via Dig Safe email alias: Dig.Safe@unh.edu

I. Dig Safe requests require 5 business days to process (excludes weekends and federal, state and University holidays).

J. Emergency Dig Safe requests are to be initialized only when “…a sudden or unexpected occurrence involving a clear and imminent danger demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property, or essential public services.” (PUC 802.03).
K. Processed Dig Safe requests will receive a Dig Safe Number, Dig Safe Date, Dig Safe Time, and Renew by Date.
   1) Site excavation may not begin until after the Dig Safe date and time.
   2) Dig Safe Number will expire 30 calendar days from the time ECD-GIS submits the request to Dig Safe Inc.
   3) Projects longer than 30 days in duration will be required to submit a renewal request by the Renew by Date.
   4) Renewal Requests submitted after the Renew by Date will not be accepted.

L. If a Dig Safe number expires, and a renewal has not been submitted, site excavation must stop and a new Dig Safe request must be submitted.

M. ECD-GIS will maintain complete records of all Dig Safe request forms and provide copy of the documentation to the requestor via PDF format.

N. Underground facilities will be marked according to the American Public Works Association color codes and marking procedure.

O. Once located, utility markings will be maintained by the requestor as per state law.

Approved: May 27, 2010
SECTION 01300 – SURVEY INFORMATION – PROCUREMENT AND CONTRACTING REQUIREMENTS

1.1 PRECISION MEASUREMENTS (conventional closed traverse)
   A. Unadjusted Linear Misclosure 1:30,000.
   B. Min. Scale Graduation of Instrument 20 sec.
   C. Distance Measurement EDM/Steel Tape.

1.2 ACCURACY MEASUREMENTS (GPS survey or survey adjusted using least squares).
   A. Minimum positional tolerances of land property corners computed least squares adjustment at the 95% confidence level as set forth in appendix b of the Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques, Federal Geodetic Control Committee.
   B. Local Accuracy of directly occupied corners 0.05 ft (1.7cm) + 1:30000.
   C. Local Accuracy of control supporting the survey 0.03 ft (1cm) + 1:30000.

1.3 APPLICABLE SPECIFICATIONS
   A. All survey field work, including GPS work, shall be performed with methods of practice and equipment capable of attaining the tolerances as specified, including the following:
      1. Elimination and reduction of known systematic errors and mistakes;
      2. Sufficient redundancy to clearly state that the accuracy requirements have been achieved;
      3. Analysis of field procedures and data processing to achieve the accuracy and precisions; and
      4. Documentation verifying compliance with these standards.
   B. All survey instruments shall be kept in good repair, close adjustment, and operated according to manufacturers’ specifications.
   C. All steel tapes and electronic distance measuring devices shall be routinely compared to a distance traceable to the National Bureau of Standards. A record of these comparisons shall be maintained by the surveyor.
   D. All pertinent information, measurements, and observations made in the field during the course of the survey shall be recorded as field notes in (5) below. Computer printouts of raw data downloaded from an electronic data collection device shall be considered a form of field notes.
   E. All field notes shall indicate:
1. Location;
2. Street names;
3. Client;
4. Instruments;
5. Date;
6. Field crew;
7. Weather conditions; and
8. Purpose of field work.

F. Searches for evidence believed to be ferrous or magnetic in nature shall be conducted with a magnetic or metal detector when evidence is possibly buried or not visible.

G. Survey traverses shall be based on a bearing system determined from astronomic observations, GPS observations, or from geodetic monuments incorporated into the traverse. If neither method is practical the survey shall be based on a magnetic bearing observed with a compass having a scale permitting interpolations to one-half of a degree. An alternate method shall be orientation of the survey to an existing survey. Angular measurements of the field traverse shall be repeated 2 or more times and each set of angular measurements shall be made with the telescope both in the direct and inverted by 180 degree position.

H. Sideshots from the traverse to monumentation or other physical features controlling the position of a property line shall be minimized. Angle measurements to those points shall be repeated 2 or more times. Distance measurements to those points shall not be greater than 100 feet when measured with a steel tape. Precision of measurements from the control points to sideshot points shall be a minimum of half the horizontal angle scale reading with distance measured to the hundredth of a foot. The exceptions to this shall be stone walls and fence posts which may be measured to the nearest tenth of a foot, and centerline and edges of water bodies which may be measured to the nearest foot.


J. A minimum of 2 benchmarks shall be established on the subject tract. Benchmarks shall be 3-4” brass disks set in at least 4’ of concrete with a minimum 12” diameter (identified and numbered per UNH), all benchmarks shall be enabled to be located with a magnetic location device. Benchmarks shall be referenced to the datum identified in above paragraph I.

K. The establishment of benchmarks shall be done with care and sufficient redundancy to ensure that the elevations are accurate and reproducible. Whenever possible and practical, a minimum of 2 known benchmarks shall be included in all level runs. All level runs shall either begin and close on separate known marks, or shall be a closed loop beginning and ending on the same known mark. Benchmarks shall be established by differential leveling using an instrument equipped with an automatic compensator or spirit level vials. The misclosure tolerance between benchmarks shall be 0.05’ divided by the square root of M where M is the one-way distance in miles. The misclosure
tolerance of a closed loop shall be 0.04' divided by the square root of M where M is the distance of the loop in miles.

L. All topographic surveys shall be referenced to a vertical control system comprised of closed level loops.

M. All site surveys shall include the location of all trees 6" and greater, shrubs and other landscaped features.

N. Grid lines for detailed cross-section work shall be closed and tied to the control system.

O. If any method of accumulating field data shall include running secondary traverses or level loops they shall begin and end at points on the control system.

P. When aerial photogrammetry is to be used to compile a topographic map the horizontal and vertical photo control points shall be incorporated into the control traverse and level loop.

Q. Measurements to physical features or improvements shall be taken with a precision compatible with the detail being located as follows:

1. Linear measurements shall be taken to the nearest foot when locating feature such as but not limited to: streams, ditches, ledge outcrops, boulders and wetlands. All other physical features shall be located to 0.1' to include but not limited to: poles, pavements, curbing, sidewalks, manholes, catch basins, culverts and signs.

2. Horizontal and vertical angles to the features shall be taken to a minimum of 20 seconds.

3. Elevations shall be taken to the nearest hundredth of a foot on building floors, manhole rims, curbing, pipe inverts, pavements; and

4. Natural ground elevations and water levels shall be taken to the nearest tenth of a foot.

R. Measurements shall be taken to a precision compatible with the construction tolerances for the project.

S. Construction layout monuments shall be of a type and character and set in a manner so as to provide a degree of permanency consistent with the terrain, physical features and intended use. Sufficient monuments and offset information shall be provided to enable the user to check the accuracy of any points or lines established there from. Any stakes that show offsets and/or cut and fill data shall also show sufficient information to identify the horizontal position of the points to which they refer.

T. All buildings, structures, or foundation layouts shall have the perimeter closed, or in the case of a rectangle, the diagonals measured.

1.4 PLATS

A. For results of surveys where a plat is prepared, the plat shall be drawn on reproducible medium. The plat shall identify the tract or parcel and contain enough information so
that the boundaries of the parcel of interest can be located with certainty in the future by a competent land surveyor.

B. As appropriate to the purpose of the survey, a survey plat shall contain but not be limited to containing the following:

1. The municipality, date, scale, bar scale;
2. The name and address of the company and or individual which prepared the plat, or both, and the name and seal of the licensed land surveyor;
3. Owner of record with mailing address, and title reference;
4. Meridian arrow and origin with the date of observation or reference plat;
5. Vicinity map;
6. Bearing and horizontal distances on all pertinent property lines;
7. Curved boundary lines showing radius, delta, and length;
8. On non-tangent curves, a course and distance of the long chord shall be shown;
9. Irregular boundaries without curves, such as rivers or streams, or with curves which have no definable geometry, shall have sufficient information to mathematically close the plat;
10. Tie lines, when used, shall be noted that they are not property lines;
11. All monuments set or found, including monuments with tie lines on which establishment of the corners of the surveyed premises are dependent;
12. Monuments shall be described as to material, the date the monument was set, and the relation of the monument to the surveyed lines and/or corner;
13. Lines of possession where they affect the surveyed boundaries;
14. Abutters with title reference and assessor’s parcel number;
15. Easement and right-of-way limits, protective covenants, references to easements and encumbrances of record, whether private or public, and evidence of any unwritten interests observed.
16. Revision dates and purposes;
17. Legend, unless symbols are clearly identified within the plat;
18. Man-made structures pertinent to the purpose of the surveyed project;
19. Natural features i.e. trees, shrubs and landscaped elements. To include a table identifying species.
20. List of documents, plats and data relevant to the survey;
21. Any record evidence of a cemetery or burial ground shall be duly noted on the plat unless such cemetery or burial ground is located on the plat;
22. The area of the subject tract or parcel, expressed in acres, unless the area is less than 2 acres, in which case the area may be expressed in square feet;
23. All benchmarks shall be adequately described on topographic surveys or boundary surveys when property lines are defined by an elevation to enable it to be recovered at a later date;
24. A certification by the land surveyor stating the method and classification of the survey and the precision and accuracy attained.
25. If coordinates of positions are shown the following shall also be included:
   a. The units of reported coordinates;
   b. The horizontal datum and coordinate system of the horizontal coordinates;
   c. Vertical datum of the vertical coordinates; and
   d. Basis of bearings.
   a. 3 sets of D size paper copies.
   b. 1 set of D size Mylar reproducible drawings.
   c. CD or DVD with digital files of formatted drawing and computer modeling files (AutoCAD 2000 or newer - .dwg format or ESRI shapefiles).
   d. Drawing layers shall be feature driven.

27. If the survey is a boundary or property survey a plan shall be recorded in the county registry of deeds. The plan recording number should be noted in all plans specified in 26 above.

END OF SECTION 01300
SECTION 01352 - LEED REQUIREMENTS LEED VERSION 3 OR ALTERNATIVE OWNER APPROVED EQUIVALENT CERTIFICATION PROCESS.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Chapter 5, Division 1 Specification Sections, apply to this Section.

B. University LEED Score Card- Attachment D at the end of this document. Based on LEED Version 3.0.

1.2 SUMMARY

A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to attempt or obtain minimum LEED Silver certification based on LEED-NC, version 3.0 or alternative owner approved equivalent certification process.

1. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.

2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

3. A copy of the LEED Project checklist is attached at the end of this Section for information only.

B. Related Sections:

1. Chapter 5, Divisions 1 through 17 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to the LEED version 3.0 rating system.

1.3 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-FSC-accredited certification body.

B. LEED: Leadership in Energy & Environmental Design.
C. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

D. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) (as the crow flies) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

E. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles (800 km) (as the crow flies) from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

F. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles (800 km) from Project site.

G. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

   1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

   2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

H. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).

   1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.

   2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

1.4 SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Material covered in Chapter 5, Divisions 1 -12.

D. Action Plans: Provide preliminary submittals within 14 days of date established for commencement of the Work indicating how the following requirements will be met:

1. Credit MR 2.1 and Credit MR 2.2: Waste management plan complying with Chapter 5, Division 1, Section 01524.
2. Credit MR 3: List of proposed salvaged and refurbished materials. Identify each material that will be salvaged or refurbished, including its source, cost, and replacement cost if the item was to be purchased new.
3. Credit MR 4.1 and Credit MR 4.2: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
4. Credit MR 5.1 and Credit MR 5.2: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
5. Credit MR 5.1 and Credit MR 5.2: List of proposed regionally manufactured materials and regionally extracted and manufactured materials.
   a. Identify each regionally manufactured material, including its source and cost.
   b. Identify each regionally extracted and manufactured material, including its source and cost.
6. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
7. Credit IEQ 3: Construction indoor-air-quality management plan.

E. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Credit MR 2.1 and Credit MR 2.2: Waste reduction progress reports complying with Chapter 5, Division 1, Section 01524.
2. Credit MR 3: Salvaged and refurbished materials.
3. Credit MR 3.1 and Credit MR 3.2: Salvaged and refurbished materials.
5. Credit MR 5.1 and Credit MR 5.2: Regional materials.
6. Credit MR 5.1 and Credit MR 5.2: Regionally manufactured materials and regionally extracted and manufactured materials.
7. Credit MR 7: Certified wood products.

F. LEED Documentation Submittals:

1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption
1. Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.

9. Credit IEQ 3:

   a. Construction indoor-air-quality management plan.
   b. Product data for temporary filtration media.
   c. Product data for filtration media used during occupancy.
   d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.

10. Credit IEQ 3.2:

    a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
    b. Product data for filtration media used during flush-out and during occupancy.
c. Report from testing and inspecting agency indicating results of indoor-air-
quality testing and documentation showing compliance with indoor-air-
quality testing procedures and requirements.

11. Credit IEQ 4.1: Product data for adhesives and sealants used inside the
weatherproofing system indicating VOC content of each product used. Indicate
VOC content in g/L calculated according to 40 CFR 59, Subpart D.

12. Credit IEQ 4.2: Product data for paints and coatings used inside the
weatherproofing system indicating chemical composition and VOC content of
each product used. Indicate VOC content in g/L calculated according to
40 CFR 59, Subpart D.

13. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber
products or wood glues indicating that they do not contain urea-formaldehyde
resin.

G. University LEED Score Card: Shall be documented and signed by the Owner,
Architect and Contractor verifying that Silver LEED version 3.0 equivalent has been
achieved for all projects not formally submitted for USGBC LEED certification.

1.5 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to
coordinate LEED requirements. LEED coordinator may also serve as waste
management coordinator.

PART 2 - PRODUCTS

2.1 SALVAGED AND REFURBISHED MATERIALS

A. Credit MR 3.: Provide salvaged or refurbished materials for a minimum of 10 percent
of building materials (by cost).

1. Credit MR 3.1 and Credit MR 3.2: Provide salvaged or refurbished materials for
a minimum of 5 - 10 percent of building materials (by cost).

2.2 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4.1 and Credit MR 4.2: Provide building materials with recycled content
such that post-consumer recycled content plus one-half of pre-consumer recycled
content constitutes a minimum of 10 or 20 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content of an item shall be determined by
dividing weight of post-consumer recycled content in the item by total weight of
the item and multiplying by cost of the item.

2. Do not include furniture, plumbing, mechanical and electrical components, and
specialty items such as elevators and equipment in the calculation.
2.3 REGIONAL MATERIALS

A. Credit MR 5.1 and Credit MR 5.2: Provide a minimum of 10 or 20 percent of building materials (by cost) that are regional materials.

B. Credit MR 5.1: Provide a minimum of 20 percent of materials (by cost) that are regionally manufactured materials.

C. Credit MR 5.2: Provide a minimum of 10 percent of materials (by cost) that are regionally extracted and manufactured materials.

2.4 CERTIFIED WOOD

A. Credit MR 7: Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
   a. Rough carpentry.
   b. Miscellaneous carpentry.
   c. Heavy timber construction.
   d. Wood decking.
   e. Metal-plate-connected wood trusses.
   f. Structural glued-laminated timber.
   g. Finish carpentry.
   h. Architectural woodwork.
   i. Wood paneling.
   j. Wood veneer wall covering.
   k. Wood flooring.
   l. Wood lockers.
   m. Wood cabinets.
   n. Furniture.

2.5 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:

1. Wood Glues: 30 g/L.
2. Metal to Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
<table>
<thead>
<tr>
<th>No.</th>
<th>Adhesives/Compounds</th>
<th>VOC Limit (g/L)</th>
</tr>
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<tbody>
<tr>
<td>7.</td>
<td>Carpet Pad Adhesives</td>
<td>50</td>
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<tr>
<td>8.</td>
<td>VCT and Asphalt Tile Adhesives</td>
<td>50</td>
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<tr>
<td>9.</td>
<td>Cove Base Adhesives</td>
<td>50</td>
</tr>
<tr>
<td>10.</td>
<td>Gypsum Board and Panel Adhesives</td>
<td>50</td>
</tr>
<tr>
<td>11.</td>
<td>Rubber Floor Adhesives</td>
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<tr>
<td>12.</td>
<td>Ceramic Tile Adhesives</td>
<td>65</td>
</tr>
<tr>
<td>13.</td>
<td>Multipurpose Construction Adhesives</td>
<td>70</td>
</tr>
<tr>
<td>14.</td>
<td>Fiberglass Adhesives</td>
<td>80</td>
</tr>
<tr>
<td>15.</td>
<td>Contact Adhesive</td>
<td>80</td>
</tr>
<tr>
<td>16.</td>
<td>Structural Glazing Adhesives</td>
<td>100</td>
</tr>
<tr>
<td>17.</td>
<td>Wood Flooring Adhesive</td>
<td>100</td>
</tr>
<tr>
<td>18.</td>
<td>Structural Wood Member Adhesive</td>
<td>140</td>
</tr>
<tr>
<td>19.</td>
<td>Special Purpose Contact Adhesive (melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface)</td>
<td>250</td>
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<tr>
<td>20.</td>
<td>Top and Trim Adhesive</td>
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<tr>
<td>21.</td>
<td>Plastic Cement Welding Compounds</td>
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<td>22.</td>
<td>ABS Welding Compounds</td>
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<td>23.</td>
<td>CPVC Welding Compounds</td>
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<td>24.</td>
<td>PVC Welding Compounds</td>
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<td>25.</td>
<td>Adhesive Primer for Plastic</td>
<td>550</td>
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<td>27.</td>
<td>ABS Welding Compounds</td>
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<td>CPVC Welding Compounds</td>
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<td>29.</td>
<td>PVC Welding Compounds</td>
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<td>30.</td>
<td>Adhesive Primer for Plastic</td>
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<td>Sheet Applied Rubber Lining Adhesive</td>
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<td>32.</td>
<td>Aerosol Adhesive, General Purpose Mist Spray</td>
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<td>33.</td>
<td>Aerosol Adhesive, General Purpose Web Spray</td>
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<td>Special Purpose Aerosol Adhesive (All Types)</td>
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<td>Other Adhesives</td>
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<td>Single-Ply Roof Membrane Sealants</td>
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<td>Other Sealants</td>
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<td>Sealant Primers for Nonporous Substances</td>
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<td>Sealant Primers for Porous Substances</td>
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<td>Modified Bituminous Sealant Primers</td>
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<td>43.</td>
<td>Other Sealant Primers</td>
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</table>

**B. Credit IEQ 4.2:** For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D and the following chemical restrictions:

1. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
2. Nonfat Paints, Coatings, and Primers: VOC not more than 150 g/L.
3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
6. Floor Coatings: VOC not more than 100 g/L.
7. Shellacs, Clear: VOC not more than 730 g/L.
8. Shellacs, Pigmented: VOC not more than 550 g/L.
9. Stains: VOC not more than 250 g/L.
10. Flat Interior Topcoat Paints: VOC not more than 50 g/L.
11. Nonflat Interior Topcoat Paints: VOC not more than 150 g/L.
12. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
13. Clear Wood Finishes, Varnishes and Sanding Sealers: VOC not more than 350 g/L.
14. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
15. Floor Coatings: VOC not more than 100 g/L.
16. Shellacs, Clear: VOC not more than 730 g/L.
17. Shellacs, Pigmented: VOC not more than 550 g/L.
18. Stains: VOC not more than 250 g/L.
19. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
20. Dry-Fog Coatings: VOC not more than 400 g/L.
22. Pretreatment Wash Primers: VOC not more than 420 g/L.
23. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
24. Restricted Components: Paints and coatings shall not contain any of the following:

   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.
C. Credit EQ 4.4: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based.

B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons.

3.2 MEASUREMENT AND VERIFICATION


B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of post-construction occupancy.

3.3 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2.1 and Credit MR 2.2: Comply with Chapter 5, Division 1, Section 01524.

3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQ 3: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

   1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period the Contractor shall install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.

   2. Replace all air filters immediately prior to occupancy.

B. Credit IEQ 3.2: Comply with one of the following requirements:
1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. (4 300 000 L) of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 deg F (16 deg C) and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. (1 070 000 L) of outdoor air per sq. ft. (sq. m) of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. (1.52 L/s per sq. m) of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. (4 300 000 L/sq. m) of outside air has been delivered to the space.

3. Air-Quality Testing:
   a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED-NC: Reference Guide."
   b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
      1) Formaldehyde: 50 ppb.
      2) Particulates (PM10): 50 micrograms/cu. m.
      3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
      4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
      5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
   c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from same locations as in the first test.
   d. Air-sample testing shall be conducted as follows:
      1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
      2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 01352

ATTACHMENTS:
Attachment A: Recycled content Materials
Attachment B: Local/Regional Materials
Attachment C: Manufacturer Certification for LEED Credit
Attachment D: UNH project Checklist Based on LEED 3.0
ATTACHMENT A – RECYCLED CONTENT MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 5% of the total value of the materials in the project. The value of the recycled content portion of a material or furnishing shall be determined by dividing the weight of recycled content in the item by the total weight of all material in the item, then multiplying the resulting percentage by the total value of the item.

B. The spreadsheet shall use the following equation:

1. Recycled Content = (Weight of Recycled Content in the Item) / (Total Weight of all Material in the Item) x Total Value ($) of Item.

C. Provide recycled content data on spreadsheet for each specification section that requires the use of recycled content materials.

D. Local/Regional Materials Spreadsheet: See Chapter 5, Division 1, Section 01352 – Attachment C.
E. Recycled Content Materials Spreadsheet:

<table>
<thead>
<tr>
<th>Section (i.e. 09680)</th>
<th>Description of Material (i.e. Carpet)</th>
<th>Material Cost ($) (Less Labor and Equipment)</th>
<th>Total Material Weight (lbs)</th>
<th>Recycled Content Calculation</th>
<th>Post-Consumer Weight (lbs)</th>
<th>½ Post-Industrial Weight (lbs)</th>
<th>Total Recycled Content Weight (lbs)</th>
<th>Recycled Content Percentage (%)</th>
<th>Value of Recycled Content ($)</th>
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</tbody>
</table>

TOTALS:

RATIO OF RECYCLED CONTENT VALUE/ TOTAL PROJECT MATERIAL VALUE:

END OF ATTACHMENT A
ATTACHMENT B – LOCAL/REGIONAL MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide 20% of building materials and products (computed by cost) manufactured regionally, within 500 miles (800 km) of the Project site.

B. Provide the location of the material manufacturer, the distance from the manufacturer to the Project site, the costs of all materials for the Project, and the percentage of building materials that are manufactured within 500 miles (800 km) of the Project.

C. Provide data on spreadsheet for each specification section that requires the use of materials manufactured locally.
D. Local/Regional Materials Spreadsheet:

<table>
<thead>
<tr>
<th>Section (i.e. 09680)</th>
<th>Description of Material (i.e. Carpet)</th>
<th>Manufacturer</th>
<th>Manufacturer Location (City, State)</th>
<th>Distance from Job Site (Miles)</th>
<th>Materials Cost ($)</th>
<th>Less Labor &amp; Equipment</th>
<th>Local Manufacturing Materials Cost ($)</th>
<th>Less Labor &amp; Equipment</th>
<th>Local Extraction Materials Cost ($)</th>
<th>Less Labor &amp; Equipment</th>
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</tbody>
</table>

**TOTALS:**

TOTAL LOCALLY MANUFACTURED PERCENTAGE (MIN. 20% TO QUALIFY):

TOTAL LOCALLY EXTRACTED PERCENTAGE (MIN. 50% TO QUALIFY):

END OF ATTACHMENT B
MANUFACTURER CERTIFICATION FOR LEED CREDIT

I/We, the manufacturer of ________________________________
as specified in Specification Section Number ______________ of the Contract Documents
prepared by: ________________________________________________

[Name and Address of Architect]

For the Project: ________________________________________________

[Name of Project]

I/We do, (does) hereby certify that:

1. The value of the materials provided is $__________________________.

2. The materials fabricated for said project were manufactured at ____________________________

[Indicate City/State]

which is ____________________________ miles from the project site.

Manufacturing refers to the final assembly of components into the building product that is furnished and installed by tradesmen. For example, if the hardware comes from Seoul, Korea, the lumber from Vancouver, British Columbia, and the joist is assembled in Kent, Washington; then the location is the final assembly in Kent, Washington.

3. The materials for said project were extracted, harvested, or recovered at ________________________

[Indicate City/State]

which is ____________________________ miles from the project site.

4. The manufactured product contains ________% Post Consumer recycled materials and ________% Pre Consumer recycled materials.

5. The manufactured product does / does not contain VOC’s. Product data submitted under separate cover. Furnish Material Safety Data Sheets.

Circle One

6. The manufactured product does / does not contain certified wood. Product data submitted under separate cover.

Circle One

7. The product contains no added Urea-Formaldehyde Resins, Composite Wood or Agrifiber Products. Yes / No

Circle One
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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>8.</td>
<td>Energy Star Product: Yes / No</td>
<td>Circle One</td>
</tr>
<tr>
<td>10.</td>
<td>Certified content in accordance with Forest Stewardship Council Guidelines: Yes / No</td>
<td>Circle One</td>
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<tr>
<td>11.</td>
<td>CFC Content: Yes / No</td>
<td>Circle One</td>
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<tr>
<td>12.</td>
<td>CFC Based Refrigerant: Yes / No</td>
<td>Circle One</td>
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</tbody>
</table>

Manufacturer: ____________________________

Certification By: ____________________________ Date: ____________

[Signature]

Name: ____________________________ Title: ____________________________

[Print Name]
# UNH Project Checklist Based on LEED 3.0

**Project Name:**

**Date:**

### PROJECT TOTALS:

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<th>Sustainable Site</th>
<th>Total Points Available</th>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
<th>UNH CAT Credits</th>
<th>Projected Actual Points</th>
<th>Remarks</th>
<th>Responsible For Documentation</th>
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<td>ALL UNH projects with site work must</td>
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<td>Site Selection</td>
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<td>Brownfield Redevelopment</td>
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<td>Alternative Transportation - Bicycle Storage and Changing Rooms</td>
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<td>Alternative Transportation - Low-Emitting and Fuel-Efficient Vehicles</td>
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<td>Alternative Transportation - Parking Capacity</td>
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<td>Site Development - Protect or Restore Habitat</td>
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<td>Site Development - Maximize Open Space</td>
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<td>Stormwater Design - Quantity Control</td>
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<td>Heat Island Effect - Nonroof</td>
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<td>Heat Island Effect - Roof</td>
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<td>Site Construction - Protection of Trees</td>
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<td><strong>PROJECT TOTALS:</strong></td>
<td>121</td>
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<td>0</td>
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<td>0</td>
<td>Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110 points</td>
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### Water Efficiency

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<tr>
<th>Water Use Reduction</th>
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<th>No</th>
<th>UNH CAT Credits</th>
<th>Projected Actual Points</th>
<th>Remarks</th>
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### CHAPTER 5 - TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS

LEED REQUIREMENTS - ATTACHMENT D

01352 Attachment D-1
### Energy & Atmosphere

#### Fundamental Commissioning of Building Energy Systems

<table>
<thead>
<tr>
<th>Credit</th>
<th>UNH CAT Credits</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Lab</td>
<td>5</td>
<td>Minimum level for wet lab buildings</td>
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#### Minimum Energy Performance

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<tr>
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<tbody>
<tr>
<td>Office/CR</td>
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<td>Minimum level for office/classroom bldg</td>
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#### Fundamental Refrigerant Management

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<th>Credit</th>
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<tr>
<td>Improve by 24% for New Buildings or 20% for Existing Building Renovations</td>
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#### Optimize Energy Performance

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<td>On-Site Renewable Energy</td>
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#### Enhanced Commissioning

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<th>Credit</th>
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#### Measurement and Verification

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### UNH Project Checklist Based on LEED 3.0

#### Project Name: 

#### Date: 

### PROJECT TOTALS:

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<thead>
<tr>
<th>Total Points Available</th>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
<th>UNH CAT Credits</th>
<th>Projected Actual Points</th>
<th>Remarks</th>
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Certified 40 to 49 points  Silver 50 to 59 points  Gold 60 to 79 points  Platinum 80 to 110 points

#### Materials & Resources

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description / Prereq</th>
<th>Notes</th>
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<tr>
<td>1-2</td>
<td>Storage &amp; Collection of Recyclables</td>
<td>Prereq 1</td>
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<td>Building Reuse-Maintain Existing Walls, Floors, and Roof</td>
<td>Credit 1.1</td>
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<td>1-3</td>
<td>Reuse 55%</td>
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<td>2</td>
<td>Reuse 75%</td>
<td>2 0</td>
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### UNH Project Checklist Based on LEED 3.0

**Project Name:**

**Date:**

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- No: 0
- Projected Actual Points: 0
- Remarks: 0

**UNH CAT Credits**

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- Silver 50 to 59 points
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- Platinum 80 to 110 points

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SECTION 01356 – INDOOR AIR QUALITY (IAQ) REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general requirements and procedures for compliance with indoor air quality requirements.

1.2 REFERENCES

A. SMACNA’S “IAQ Guidelines for Occupied Buildings Under Construction”: Referenced standard for measures to protect the building HVAC system during construction and demolition activities. Provides an overview of air pollutants associated with construction, control measures, construction process management, quality control, communicating with occupants, and case studies.

B. ANSI/ASHRAE 52.2 – 1999 “Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size”: Methods for testing air cleaners for two (2) performance characteristics; the ability of the device to remove particles from the air stream and the device’s resistance to airflow. Standard for a complete explanation of MERV value calculations. Filtration media used during the construction process shall have a minimum MERV of 13.

1.3 DEFINITIONS

A. SMACNA: Sheet Metal and Air Conditioning National Contractor’s Association.

B. MERV: Minimum Efficiency Reporting Value.

C. Type 1 Finishes. Materials and finishes which have the potential for short-term off-gassing, because of the way they are manufactured or because they contain solvents which evaporate during drying or curing. Type 1 finishes include:

1. Architectural coatings.
2. Adhesives, caulks and sealants.
3. Wood preservatives and finishes.
4. Control and/or expansion joint fillers.
5. All hard finishes requiring adhesive installation.
6. Composite wood products, including millwork, wood paneling, doors or furniture made from particle board or medium density fiberboard containing urea formaldehyde resin.
7. Materials and finishes that can be categorized as both a Type 1 finish and a Type 2 finish.

D. Type 2 Finishes. Materials that are woven, fibrous or porous in nature and finishes which tend to adsorb contaminants associated with Type 1 finishes. They also collect dust and can retain moisture, promoting mold growth. Type 2 finishes include:

1. Carpet and carpet cushion.
2. Fabric-covered partitions and acoustic wall panels.
3. Fabric wall coverings.
5. Upholstered furniture.

1.4 PERFORMANCE REQUIREMENTS

A. General: Develop Indoor Air Quality Management Plan that results in meeting or exceeding the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 1995.

1.5 SUBMITTALS

A. Submittals contained herein are in addition to other submittals required in the technical specifications. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated IAQ requirements.

B. Action Plans: Provide preliminary submittals within 14 days of date established for commencement of the Work indicating how the following IAQ requirements will be met.

1. Indoor Air Quality Management Plan During Construction:
   a. Construction indoor air quality management plan highlighting areas and methods of compliance.
   b. Product Data for temporary filtration media.
   c. Product Data for temporary filtration media used during construction and installed immediately prior to occupancy with MERV values highlighted.
   d. Construction Documentation: Six photographs at three different occasions during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

2. Submit a special construction schedule to prevent Type 2 Finishes from acting as sinks for storage and subsequent release of contaminants emitted from Type 1 Finishes.
   a. Include appropriate allowances for drying or curing times of Type 1 Finishes before installation of Type 2 Finishes, based on technical specifications provided by the manufacturers.

3. Substantial Completion Indoor Air Quality Management Plan:
a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
b. Product Data for filtration media used during flush-out and during occupancy.
c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing conformance with IAQ testing procedures and requirements.

C. Qualification Data: For Project Representative with daily responsibilities for IAQ issues.

1.6 QUALITY ASSURANCE

A. Preconstruction Conference: Conduct conference at Project site to comply with requirements in Chapter 5, Division 1. Review methods and procedures related to Indoor Air Quality requirements including, but not limited to, the following:

1. Include procedures related to the IAQ Management Plan During Construction on the agenda during every pre-construction meeting and during every regularly scheduled Project meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INDOOR AIR QUALITY MANAGEMENT PLAN DURING CONSTRUCTION

A. General: Comply with SMACNA IAQ Guideline for Occupied Buildings under Construction.

1. Include measures to protect the ventilation system components and air pathways against contamination during construction. The Plan must include cleaning procedures to be employed prior to the building being occupied, in the event that ventilation system components and air pathways are not adequately protected.

2. Indicate the location, type, amount, sequence, and timing of the various control measures, including emergency procedures, and the labor, materials, and the time required to implement them.

B. Develop Indoor Air Quality Management Plan Incorporating Each of the Following Control Measures:

1. HVAC protection.
2. Contaminant source control.
3. Interruption of moisture/pollutant pathway.
4. Housekeeping.
5. The location, type, amount, sequence and timing of the various control measures, including emergency procedures, and the labor, materials and time required to implement them.
6. Scheduling of events to protect indoor air quality by:

   a. Permitting adequate airing-out of new materials,
   b. Sequencing the installation of finish materials,
   c. Proper curing of concrete before covering,
d. Installation during unoccupied periods,
e. Avoidance of building occupancy while construction-related pollutants are still present.

8. Reducing products of combustion by venting vehicles, construction equipment, generator, and heaters to the exterior.

C. Designate a representative with daily responsibility for IAQ issues:
   1. Include procedures related to the IAQ Management Plan During Construction on the agenda during every pre-construction meeting and during every regularly scheduled meeting.

D. Store building materials in a weather-tight, clean area protected from dust, debris and moisture damage.

E. Keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the work. Identify the storage, disposal and Housekeeping practices to be applied to building supplies and waste materials to protect building systems from contamination.

F. Provide 100 percent outside air continuously during installation of materials and finishes, beginning after the building is substantially enclosed. Where a supply air system is already installed, it must have filters in place before work begins.

G. The permanent HVAC system may be used to move both supply and return air provided the following conditions are met:
   1. Replace all construction-related filtration media used on permanent HVAC equipment at substantial completion of the work.
   2. Confirm that all air filters, casing, coils, fans and ducts are clean, before TAB, and air quality testing.
   3. Permanent return air ducts must be inspected and/or cleaned to comply with minimum requirements of General Specifications for the Cleaning of HVAC Systems published by the National Air Duct Cleaning Association www.nadca.com.
   4. Coordinate duct testing and cleaning procedures with the commissioning requirements set forth in Chapter 5, Division 1, Section 01815 to ensure that they may be witnessed and documented by the commissioning authority.

H. Provide the Owner a building clean, dry and free of debris.

I. If Owner authorizes the use of permanent heating, cooling, and ventilating systems during construction period the Contractor shall install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
   1. Replace all air filters immediately prior to occupancy and again prior to building air flush-out. Replacement air filters shall have a MERV 13 according to ASHRAE 52.2.

3.2 SUBSTANTIAL COMPLETION INDOOR AIR QUALITY MANAGEMENT PLAN
A. Credit EQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period the Contractor shall install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.

2. Replace all air filters immediately prior to occupancy.

B. Credit EQ 3.2: Comply with one of the following requirements:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. (4 300 000 L) of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 deg F (16 deg C) and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. (1 070 000 L) of outdoor air per sq. ft. (sq. m) of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. (1.52 L/s per sq. m) of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. (4 300 000 L/sq. m) of outside air has been delivered to the space.

3. Air-Quality Testing:
   
a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED-NC: Reference Guide."
   
b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

   1) Formaldehyde: 50 ppb.
   2) Particulates (PM10): 50 micrograms/cu. m.
   3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
   4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
   5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

   c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
   
d. Air-sample testing shall be conducted as follows:

   1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air...
flow rate for the occupied mode throughout the duration of the air testing.

2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.

3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 01356
SECTION 01500 – CONSTRUCTION PROJECT SIGNAGE

PART 1 - GENERAL

1.1 PROJECT IDENTIFICATION SIGN

A. Project Managers will determine if a project sign is to be provided. Generally, all projects exceeding $1 million in project cost will have a sign.

B. Utilize a professional sign maker to furnish and erect one 4 by 8 foot sign, with three 4"x4" wood post supports and angled wood bracing. Fabricate from one inch thick one sided medium density overlaid exterior plywood. Give all surfaces of the sign and supports one coat of S-W-A 100 exterior latex wood primer or equal, two coats of S-W-A 100 exterior latex gloss enamel or equal (Color is aka Krylon “Regal Blue”). Design and letter sign by a professional sign maker and indicate the following:

1. Name of Project.
2. Image of Project, when appropriate. (Image will be provided by UNH FD&C to the Contractor).
3. Name of Owner.
4. Name of General Contractor or Construction Manager.
5. Name of Architect.

C. Submit shop drawings to Architect and Owner for review.

D. Sign will be installed at a location designated by the University Facilities Design and Construction (FD&C) within 15 working days after the signing of the construction contract.

1.2 PROJECT HISTORICAL INFORMATION SIGN

A. Project Managers will determine the need for an informational sign on a project by project basis.

B. Furnish and erect one 2'-4" by 3 foot sign, with two 4"x4" wood post supports. Fabricate from one inch thick medium density overlaid exterior plywood. Give all surfaces of the sign and supports one coat of exterior house paint primer, two coats of exterior gloss enamel (color is University Blue). Design and letter sign by a professional sign painter and indicate the following:

1. Name of Project.
2. Narrative of Historical Story. (Usually no more than 2 paragraphs or 60 words. Text to be provided by FD&C).

C. Submit shop drawings to Architect and Owner for review.
D. Sign will be installed at a location designated by FD&C within 15 working days after the signing of the construction contract.

1.3 OTHER PROJECT RELATED SIGNAGE

A. Installation of other signs visible outside the project site shall not be allowed.

B. The Contractor may install temporary directional, safety and OSHA required signs that indicate and will enable construction personnel and visitors to locate access roads, parking, first aid stations, hoists, sanitary facilities, telephones, emergency exits, fire protection facilities, barricades, hazardous elements of construction work, obstructions, and similar need-to-know directions and information. The University Project Manager must approve the temporary signage and graphics prior to installation.

PART 2 - MATERIALS

2.1 Products:

A. Pressure-treated southern pine sign supports.

B. Medium density overlay (one-sided) exterior plywood.

C. S-W-A 100 Exterior Latex Wood Primer or equal.

D. S-W-A 100 Exterior Latex Gloss Paint or equal.

E. Vinyl Lettering.

F. Nails.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01500

ATTACHMENTS:

ATTACHMENT 1 – CONSTRUCTION PROJECT SIGNAGE
ATTACHMENT 2 – CONSTRUCTION PROJECT SIGNAGE
MEMORIAL UNION BUILDING
EXPANSION AND RENOVATIONS

University of New Hampshire
Facilities Design & Construction

Architects:
Perry Dean Rogers & Partners

Structural Engineers
LeMessurier Consultants, Inc.

Mechanical and Electrical Engineers
Syska & Hennessy New England

Civil Engineers
Bryant Associates, Inc.

Food Service Consultant
Birchfield Foodsystems, Inc.

General Contractor
R. C. Foss & Sons, Inc.

University of New Hampshire
Durham, New Hampshire

White Vinyl Palatino Text on Pantone 288C Blue Background
4' x 8' x 3/4" MDO Plywood (with pine banding to prevent delamination of MDO)

July, 2000

SCALE: 1" = 1'-0"

ATTACHMENT 1
MEMORIAL UNION BUILDING
EXPANSION AND RENOVATIONS

University of New Hampshire
Facilities Design & Construction

Architects:
Perry Dean Rogers & Partners

Structural Engineers
LeMessurier Consultants, Inc.

Mechanical and Electrical Engineers
Syska & Hennessy New England

Civil Engineers
Bryant Associates, Inc.

Food Service Consultant
Birchfield Foodsystems, Inc.

General Contractor
R. C. Foss & Sons, Inc.

University of New Hampshire
Durham, New Hampshire

White Vinyl Palatino Text on Pantone 288C Blue Background
4' x 8' x 3/4" MDO Plywood (with pine banding to prevent delamination of MDO)

July, 2000

SCALE: 1" = 1'-0"
SECTION 01524 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Chapter 5, Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable
means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:
   
   a. Asphaltic concrete paving.
   b. Concrete.
   c. Concrete reinforcing steel.
   d. Brick.
   e. Concrete masonry units.
   f. Wood studs.
   g. Wood joists.
   h. Plywood and oriented strand board.
   i. Wood paneling.
   j. Wood trim.
   k. Structural and miscellaneous steel.
   l. Rough hardware.
   m. Roofing.
   n. Insulation.
   o. Doors and frames.
   p. Door hardware.
   q. Windows.
   r. Glazing.
   s. Metal studs.
   t. Gypsum board.
   u. Acoustical tile and panels.
   v. Carpet.
   w. Carpet pad.
   x. Demountable partitions.
   y. Equipment.
   z. Cabinets.
   aa. Plumbing fixtures.
   bb. Piping.
   cc. Supports and hangers.
   dd. Valves.
   ee. Sprinklers.
   ff. Mechanical equipment.
   gg. Refrigerants.
   hh. Electrical conduit.
   ii. Copper wiring.
   jj. Lighting fixtures.
   kk. Lamps.
   ll. Ballasts.
   mm. Electrical devices.
   nn. Switchgear and panelboards.
   oo. Transformers.

2. Construction Waste:
   
   a. Site-clearing waste.
b. Masonry and CMU.
c. Lumber.
d. Wood sheet materials.
e. Wood trim.
f. Metals.
g. Roofing.
h. Insulation.
i. Carpet and pad.
j. Gypsum board.
k. Piping.
l. Electrical conduit.
m. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use forms attached at end of this Section. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

H. Qualification Data: For waste management coordinator and refrigerant recovery technician.

I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

J. QUALITY ASSURANCE

K. Waste Management Coordinator Qualifications: LEED Accredited Professional, certified by USGBC, as waste management coordinator. Waste management coordinator may also serve as LEED coordinator.

L. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

M. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

N. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.
1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use forms attached at the end of this Section. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use forms attached at the end of this Section. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use forms attached at the end of this Section. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Chapter 5, Division 1 for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Chapter 5, Division 1 for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Door closers, and door hardware to be salvaged by UNH Lockshop.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch (38-mm) size.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 3/4-inch (19-mm) size.

2. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.

2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

I. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
   1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

K. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

L. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees on-site.
   1. Comply with requirements in Chapter 5, Division 2, Section 02930 for use of chipped organic waste as organic mulch.

C. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
B. Burning: Do not burn waste materials. Burning is not permitted on the University of New Hampshire Campus.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

3.7 ATTACHMENTS

Form 1 - Construction Waste Identification.
Form 2 - Demolition Waste Identification.
Form 3 - Construction Waste Reduction Work Plan.
Form 4 - Demolition Waste Reduction Work Plan.
Form 5 - Cost/Revenue Analysis of Construction Waste Reduction Work Plan.
Form 6 - Cost/Revenue Analysis of Demolition Waste Reduction Work Plan.
Form 7 - Construction Waste Reduction Progress Report.
Form 8 - Demolition Waste Reduction Progress Report.

END OF SECTION 01524
### CONSTRUCTION WASTE IDENTIFICATION

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*Insert units of measure.
## DEMOLITION WASTE IDENTIFICATION

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**COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN**

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### COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN

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## Construction Waste Management – Form 6

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## CONSTRUCTION WASTE REDUCTION PROGRESS REPORT

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SECTION 01725 – STANDARD SITE PLAN CAD LAYERING SCHEMA

PART 1 - GENERAL

1.1 SUMMARY

A. All Site and Civil CAD plans must be georeferenced to the proper coordinate system (NAD 1983, NH State Plane, Feet) prior to submittal. Any plans that are not registered to the ground will be returned to the preparer.

B. The following CAD Layering standards are to be used for all site plan AutoCAD drawings (site surveys, construction documents, as-builts, etc) associated with any project. At the completion of the project the finished .DWG file(s) should then be delivered, on a CD, to the University.

C. Layers that are not included on this list are to be built in accordance with the existing layering schema (i.e. PREFIX-CLEAR DESCRIPTION AS NAME). Once created, these layers should be added to the appropriate existing group or added as a new subgroup.

D. Direct questions concerning Standard Site Plan CAD Layering standards to the Energy and Campus Development GIS Group.

E. Prefix Description:

- C: General Campus Infrastructure/Features
- DW: Domestic Water Distribution System
- EL: Electric Distribution System
- HC: Heating and Cooling Distribution System
- LA: Landscape Features
- M: Miscellaneous Layers
- NG: Natural Gas Distribution System
- NW: Natural Waterways
- SS: Sanitary Sewer Distribution System
- SW: Storm Water Distribution System
- TEL: Telecom Distribution System
- TO: Topographic Elevation Information

F. Layer Name:

- C-ABANDONED BUILDING
- C-ACCESS ROAD
- C-ANTENNAE
- C-ASPHALT PAD
- C-ATHLETIC FIELD, COURT, OTHER
- C-BLEACHER
- C-BRIDGE
- C-CONCRETE PAD
C-CROSSWALK
C-CURBING
C-DAM
C-DRIVEWAY
C-EXISTING BUILDING
C-FENCE
C-FUTURE ROAD
C-GEODETIC MONUMENT
C-ORCHARD
C-PARKING LOT
C-PARKING LOT STRIPING
C-PROPOSED BUILDING
C-RAILROAD TRACKS
C-RETAINING WALL
C-ROAD
C-ROAD CENTERLINE
C-ROAD STRIPING
C-SCOREBOARD
C-SIDEWALK
C-SIGNAGE
C-STAIRS
C-STONE WALL
C-TEXT
C-TRAIL
C-TRAILER
C-WALKWAY

DW-DOMESTIC HOT WATER RETURN LINE
DW-DOMESTIC HOT WATER SUPPLY LINE
DW-DOMESTIC WATER LINE
DW-HYDRANT
DW-IRRIGATION LINE
DW-POST INDICATOR VALVE
DW-TEXT
DW-WATER LINE CAP
DW-WATER VALVE

EL-ELECTRIC BOX
EL-ELECTRIC MANHOLE
EL-LIGHT POLE
EL-OVERHEAD ELECTRIC LINE
EL-PAD MOUNT TRANSFORMER
EL-SWITCH BOX
EL-TEXT
EL-UNDERGROUND ELECTRIC LINE
EL-UTILITY POLE

HC-CHILLED WATER SUPPLY LINE
HC-CHILLED WATER RETURN LINE
HC-CONDENSATE RETURN LINE
HC-HEATING AND COOLING MANHOLE
HC-HOT WATER RETURN LINE
HC-HOT WATER SUPPLY LINE
HC-STEAM SUPPLY LINE
HC-TEXT

LA-BOULDER
LA-BRUSH
LA-LARGE TREE
LA-MEDIUM TREE
LA-ROCKS
LA-SHRUB
LA-SMALL TREE
LA-TEXT
LA-TREE LINE

M-MISCELLANEOUS FEATURE
M-PROPERTY BOUNDARY
M-TEXT
M-UTILITY DOOR

NG-ECOLINE
NG-GAS METER
NG-GAS REDUCER
NG-GAS VALVE
NG-GAS VENT
NG-NATURAL GAS LINE
NG-PROPANE LINE
NG-PROPANE TANK
NG-TEXT
NG-TRACER BOX

NW-LAKE
NW-RESERVOIR
NW-RIVER
NW-STREAM
NW-WETLAND

SS-SEWER CLEAN OUT
SS-SEWER FORCE MAIN
SS-SEWER LIFT STATION
SS-SEWER LINE
SS-SEWER MANHOLE
SS-TEXT

SW-CATCH BASIN
SW-CLEAN OUT
SW-CULVERT
SW-DITCH OR SWALE
SW-DRAIN LINE
SW-DRAIN MANHOLE
SW-INLET
SW-OUTFALL
SW-STORM WATER TREATMENT STRUCTURE
SW-TEXT

TEL-CALL BOX
TEL-EMERGENCY PHONE
TEL-OVERHEAD TELECOM LINE
TEL-TELECOM MANHOLE
TEL-TEXT
TEL-UNDERGROUND TELECOM LINE

TO-CONTOUR LINE
TO-HORIZONTAL CONTROL
TO-SPOT ELEVATION
TO-TEXT
TO-VERTICAL CONTROL

END OF SECTION 01725
SECTION 01732 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Chapter 5, Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Refer to Chapter 5, Division 1, Section 01524 for specific construction waste management during demolition.

B. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstone and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

1. Hazardous materials will be removed by Contractor.
2. Hazardous Materials Monitoring: The Owner will provide hazardous materials monitoring for the duration of the removal project. All documentation will be reviewed by the Certified Industrial Hygienist (CIH) prior to submission to the University.
   a. The receiving landfill shall be approved prior to the removal process by the Owner and the CIH.

3. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Contractor.

D. Hazardous Materials: Hazardous materials may be present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is included in the contract documents or on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

1. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS


B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

C. LEED Requirements for Building Reuse:
   1. Credit MR 1.1: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
   2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
   2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes and templates.

   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

   1. Comply with requirements for existing services/systems interruptions specified in Chapter 5, Division 1.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

   1. Contractor will arrange to shut off indicated services/systems.
   2. Arrange to shut off indicated utilities with utility companies.
   3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Chapter 5, Division 1, Section 01524.

B. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Chapter 5, Division 1, Section 01524.

B. Burning: Do not burn demolished materials.
C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 01732
SECTION 01770 – CLOSEOUT PROCEDURES - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Record Drawings are required under the terms of the Standard University of New Hampshire construction and design services contracts.

B. The work covered by this specification consists of providing all administration, planning, labor, materials, equipment and supervision necessary to complete all operations required per specifications and drawings herein, but shall not be limited to the following:

1. Provide as-built drawings of building showing all utilities installed. Drawing shall be digital, AutoCAD latest format in *.dwg format utilizing color dependent plot styles, on hi-quality CD-R media in a non-compressed format (no zip files). In addition all record drawings shall be submitted in pdf format on separate CDs. No file protection or password protection shall be incorporated in the AutoCAD files provided to the university. One full size hard copy set of the Record drawings and one ½ set of the record drawings shall be provided to the University in addition to the electronic formats required.

   a. Provide a list, in both hard copy and electronic copy, explaining in detail all electronic files provided. The list shall contain descriptors of the drawings content (i.e., Architectural Floor Plans-Level 1, etc.), date of most recent revision, sheet numbers included in file (i.e., A-1, A-2 etc.), as well as the physical size of the electronic file.

   b. Electronic drawing files shall follow the layering standard for all architectural, plumbing, fire protection, mechanical, electrical and other drawings shall be similar to the AIA layering standard. The layering standard for Civil and Site drawings shall utilize the UNH layering standard for civil/site drawings. See Chapter 5, Division 1, Section 01725.

   c. Utilize standardized blocks throughout all electronic drawings, with all entities internal to the block to preferably be on layer 0, with color and line type of by block; for attributes their color assignment is the designer's choice. Room numbers shall be provided as attributes of a block.

   d. Each sheet shall be in a separate AutoCAD file utilizing a single AutoCAD layout. If this is not practical, then multiple sheets can be in a single AutoCAD file; however, each sheet shall be on a separate AutoCAD layout. The AutoCAD layout sheet size shall match the plotted sheet size and the Layout names shall be the sheet number. The layout's viewport visibility shall be "ready to print" and require no layer visibility manipulations by UNH for each viewport in each layout of each drawing provided.

   e. Perform the AutoCAD etransmit command on each separate AutoCAD file, and include the following support files, if the etransmit command is unavailable simply provide the following:

      1) Appropriate pen setting files (*.stb)
2) Any external references (Xrefs), Images or OLE objects used in the drawing with the path information removed.
3) Font and shape files used (*.shx, *.ttf or *.shp) in the drawing, as well as the font map file (acad.fmp or similar appropriate file).
4) Plotter setup files (*.pc3).

f. Drawing shall consist of building plan (footprint) showing building features and utilities. Layers shall conform to AIA layering format and the civil/site requirements found in Chapter 5, Division 1, Section 01725. Building base information should be available from the Owner in a digital format. Site As-Builts shall be done by a licensed land surveyor, and building As-Builts shall be done by engineer or architect licensed in the State of New Hampshire.

1) All site information for pertinent infrastructure (i.e. walkways, roadways, etc.) and utilities, including location and descriptive attributes, are to be collected at the time of installation by the contractor. The contractor will then be responsible for transmitting this information to the engineer or architect who will be preparing the final As-Builts. Status checks of this process are to be provided to the UNH Project Manager by the contractor on a monthly basis. This expectation should be clearly addressed and agreed upon at the project kick off meeting.

2) All drawings shall be in architectural units and standard architectural scales, with the exception of civil/site drawings, whose units shall be standard engineering units. North arrow shall be shown on all drawing where appropriate. All drawing shall include a site loci map for reference.

g. A preliminary set of site/civil As-Builts shall be provided to the University prior to project closeout for QA/QC review by UNH staff. Once UNH staff has reviewed said plans any necessary changes will be relayed to the preparer. Final As-Built sign off should occur at, or before, the final project close out meeting.

Operation and Maintenance Manuals: Submittal by the Contractor of Operation and Maintenance Manuals as required under Division 15, 16 and 17 specifications and acceptance thereof by the Owner shall be a prerequisite for final payment. O&M manuals shall consist of maintenance schedules, maintenance manuals, and all approved submittals presenting full details for the care and maintenance of all equipment furnished and installed under the Contract. O&M manuals shall be submitted for each Division 15 and 16 properly bound in a logical and well arranged order, with index, for Owner's use. Maintenance manuals shall consist of manufacturers' catalog cuts with descriptive information lubricating and maintenance instructions, parts lists, usage instructions, names, addresses and telephone numbers where replacement parts and service can be quickly obtained, and all other information required for the Owner to use, maintain, and service the items properly. Provide copies of O&M manuals.
h. Provide electronic copies of O & M's in .pdf format on CDs. Provide 10 copies of the electronic O & M files.

2. Guarantees/Warranties and Bonds: Compile all applicable guarantees, warranties and bonds for all materials and equipment incorporated into the Work; include written warrantees from Contractor and Subcontractors for the one-year specified general warranty period. Submit two copies.

a. Warranties shall also be submitted in electronic .pdf format. Provide 10 copies.

3. Punchlist/Certificate of Substantial Completion: The Contractor shall notify the Owner when the Work or an agreed upon portion thereof is substantially completed by issuing a Certificate of Substantial Completion (AIA Document G704) which shall establish the Date of Substantial Completion which shall be mutually agreed between the Owner and the Contractor prior to the issuance of the Certificate; shall state the responsibility of each party for security, maintenance, heat, utilities, damage to the Work and insurance; shall include a list of items to be completed or corrected (i.e. punchlist) and shall fix the time within which the Contractor shall complete the items listed therein. The Contractor shall prepare the punchlist in cooperation with the Owner Representative on site. The punchlist shall not be construed as an all-inclusive list of work which the Contractor will be required to perform prior to final payment.

4. Certificate of Occupancy: The Contractor shall provide a three ring binder of all architectural and engineering affidavits, inspections, reports, and testing results supporting the Certificate of Occupancy process. This document shall also be issued in CD format with pdf. Contractor to provide three copies.

5. Certifications: Prior to final payment, the Contractor shall provide a Fire Alarm Testing Report and Certification issued by the system supplier and/or installer. Further, the Contractor shall coordinate with the Durham Fire Department relative to the issuance of a Certificate of Occupancy for the space and shall resolve all matters of concern to the Fire Department which lie within the scope of the Work. The Fire Department will issue the C.O. directly to the University.

6. Evidence of Payments and Release of Liens: Contractor shall submit to the University duly executed documents as follows: The General Contractor's Affidavit of Payment of Debts and Claims (AIA Document G706); and The General Contractor's Affidavit of Release of Liens (AIA Document G706A) with Consent of Surety to Final Payment (AIA Document G707), General Contractor's release or waiver of liens, and separate releases or waivers of liens from Subcontractors, suppliers and others with lien rights against property of the Owner, together with a list of those parties.

7. Final Application and Certificate for Payment: Final payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor upon the Owner's receipt of the Contractor's final Application for Payment when the Work has been completed and the Contract fully performed except for those responsibilities of the Contractor which survive final payment.

8. As part of the project, the building or area renovated shall be turned over to the University completely cleaned by the Contractor and ready for occupancy. The Contractor shall provide their own equipment for clean-up and shall clean the buildings/space to meet the cleaning standards of UNH Housekeeping Services.
The Contractor shall be charged for recleaning if the building/space has not been cleaned to the satisfaction of UNH Housekeeping Services.

9. Contractors will be required to recycle as many materials as possible in order to offset disposal costs on the related projects. This is especially true with cardboard. Contract monitors can call the Recycling Office at 862-3100 for assistance with requirement.

10. Upon completion of all close out procedures, a final project close out meeting will be held which include all key players. This meeting shall act as the final check off of all requirements of the contractor/designer by the University (i.e. punchlist review, As-Built review, warranty work completion and final acceptance).
SECTION 01810 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL INFORMATION AND RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Chapter 5, Division 1 Specification Sections, apply to this Section.

B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

1.3 DEFINITIONS

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority. The University will hire an independent third party Commissioning Agent (CA). The Contractor shall work with the CA.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project
superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.
4. Contractor shall designate the MEP coordinator, Project Manager and site superintendent as members of the commissioning team.

1.5 OWNER’S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and each Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 EACH CONTRACTOR’S RESPONSIBILITIES

A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
3. Attend commissioning team meetings held on a variable basis.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly insert frequency basis.
7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
8. Complete commissioning process test procedures.

1.7 CxA’S RESPONSIBILITIES

A. Organize and lead the commissioning team.
B. Provide commissioning plan.

C. Convene commissioning team meetings, and document the meetings with minutes that will be electronically submitted to the commissioning team.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Prepare and maintain the Issues Log.

G. Prepare and maintain completed construction checklist log.

H. Witness systems, assemblies, equipment, and component startup.

I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01810
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Chapter 5, Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Chapter 5, Division 1, Section 01810 for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.


D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 CONTRACTOR’S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.
F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.5 CxA’S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.


1.6 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

1.7 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.
PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.

2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Chapter 5, Division 15, Section 15510. Provide submittals, test data, inspector record, and boiler certification to the CxA.
B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Chapter 5, Division 15. Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Chapter 5, Division 15, Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be key to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of oil, gas, coal, steam, hot-water, and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 01815
SECTION 02230 - SITE CLEARING

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing site utilities.
8. Arborist review and reporting for existing conditions and remediation post construction activities

B. General: Any construction activity within 110 feet of the ECOLine on the UNH Campus may require full time monitoring by an OQ certified person in accordance with the Code of Federal Regulations (CFR) Title 49 Part 192. Each Project will require employment of this OQ Certified person.

1. Protect and/or restore existing vegetation and habitat to remain based on efforts to achieve SS Credit 5.1

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain University's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from University and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by University or authorities having jurisdiction.
3. Provide DOT traffic and pedestrian signage as required to safely direct vehicles and pedestrians.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on University’s premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. UNH Dig Safe: http://www.unh.edu/ecd/campus_gis.html.
D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

1.4 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Chapter 5, Division 2, Section 02300.

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

1.5 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to University.

1.6 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control. http://des.nh.gov/organization/divisions/water/aot/index.htm

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

1.7 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in Chapter 5, Division 2, Section 02231.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

1.8 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Project Manager not less than three days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Project Manager’s written permission.

C. Removal of underground utilities is included in Chapter 5, Division 2 Sections.

1.9 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
2. Use only hand methods for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

1.10 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.
B. Strip topsoil to depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1.11 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

1.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off University's property.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.
SECTION 02231 - TREE PROTECTION AND TRIMMING

1.1 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the work, whether temporary or permanent construction.

1. Protect and/or restore existing vegetation and habitat to remain based on efforts to achieve SS Credit 5.1

1.2 DEFINITIONS

A. Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

1.3 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located, current member of ASCA, or registered Consulting Arborist as designated by ASCA. Arborist shall create protection, maintenance and restoration plan and submit for the project record through the Contractor.

1.4 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

1.5 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black
or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

B. Topsoil: Stockpiled topsoil from location shown on Drawings.

C. Organic Mulch: Shredded hardwood, ground or shredded bark, or wood and bark chips, free from deleterious materials.

D. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by University.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

2. Plywood Protection-Zone Fencing: Plywood framed with four 2-by-4-inch (50-by-100-mm) rails, with 4-by-4-inch (100-by-100-mm) preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.

3. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch (50-by-100-mm) horizontal rails, with 4-by-4-inch (100-by-100-mm) preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart, and lower rail set halfway between top rail and ground.

4. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart. High-visibility orange color, nonfading.

5. Height of Fencing: 4 feet (1.2 m), 6 feet (1.8 m), or 8 feet (2.4 m).

6. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.

E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering.

1.6 EXAMINATION AND PREPARATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
C. Protection Zones: Mulch areas inside protection zones and other areas indicated with 4-inch (100-mm) or 6-inch (150-mm) average thickness of organic mulch. Do not place mulch within 6 inches (150 mm) of tree trunks.

1.7 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.

2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

3. Access Gates: Install where indicated by University.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by University.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by University.

D. Maintain protection-zone fencing and signage in good condition as acceptable to University and remove when construction operations are complete and equipment has been removed from the site.

1.8 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Chapter 5, Division 2, Section 02300.

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Do not allow exposed roots to dry out before placing permanent backfill.

1.9 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Temporarily support and protect roots from damage until they are permanently covered with soil.
3. Cover exposed roots with burlap and water regularly.
4. Backfill as soon as possible according to requirements in Chapter 5, Division 2, Section 02300.

B. Root Pruning at Edge of Protection Zone: Prune roots by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1.10 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
   a. Cut branches with sharp pruning instruments; do not break or chop.
   b. Do not apply pruning paint to wounds.

B. Chip removed branches and spread over areas identified by University or stockpile in areas approved by University or dispose of off-site.

1.11 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

C. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.
1.12 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports. Final formal report shall document that the work has been conducted in accordance with the approved protection plan.

1.13 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by University.

1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
3. Perform repairs within 24 hours.
4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by University.

1.14 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off University’s property.

END OF SECTION 02231
SECTION 02300 - EARTHWORK

1.1 SUMMARY

A. Section Includes:
   1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
   2. Excavating and backfilling for buildings and structures.
   3. Drainage course for concrete slabs-on-grade.
   4. Subbase course for concrete walks and pavements.
   5. Subbase course and base course for asphalt paving.

B. The standards for plant protection in the Chapter 5, Division 1, Section 01732 and Chapter 5, Division 2, Section 02230 shall also apply to Earthwork.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 PROJECT CONDITIONS

A. Service: Notify UNH Dig Safe of the area where Project is located and ensure all proper paperwork has been submitted before beginning earth moving operations.

B. ECD GIS should be notified whenever an existing utility has been exposed or a new utility is installed (prior to backfilling) in order to collect its position via GPS. This can be coordinated through the Site Super, Clerk of the Works, or UNH Project Manager. Proper protocol should be discussed and agreed to during the project kick-off meeting.

C. Do not commence earth moving operations until plant-protection measures specified in Chapter 5, Division 2, Section 02231 are in place.

1.4 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

1.5 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored to comply with local practice or requirements of authorities having jurisdiction.

C. Tracer Wire: Refer to Chapter 5, Division 1, Section 01100 1.3 N. 1 ‘General Requirements.’

1.6 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
1.7 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions without prior consent of the Owner. Costs shall be predetermined in the allowance summary by contract.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

1.8 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Chapter 5, Division 2, Section 02231.

1.9 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

1.10 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (100 mm) deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Chapter 5, Division 2, Section 02231.

1.11 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

1.12 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

1.13 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

1.14 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.
B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Chapter 5, Division 3, Section 03300.

D. Trenches under Roadways: Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Chapter 5, Division 3, Section 03300.

E. Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

1.15 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

1.16 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

1.17 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 or ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

1.18 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

1.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
1. Shape subbase course and base course to required crown elevations and cross-slope grades.

2. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557.

1.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

1.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

1.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 02300
SECTION 02318 – BLASTING OPERATIONS

1.1 SUMMARY

A. Section Includes:

1. Regulations for blasting on Project sites.
2. Reference Chapter 5, Division 2, Section 02300 for blasting submittals, and blasting execution.

1.2 QUALITY ASSURANCE

A. Standard Specifications for Road and Bridge Construction, State of New Hampshire, Department of Transportation

B. Reference the following website for Standard Specifications:


1.3 PERMITS

A. The following documents are required to secure a blasting permit:

2. Valid State of NH License Use, Purchase and Transport.
3. Insurance Binder specifically covering blasting operations.

1.4 BLASTING HOURS

A. Hours shall be from 8:30 a.m. to 3:30 p.m., Monday through Saturday, unless otherwise stated on permit.

1.5 DURHAM DISPATCH NOTIFICATION

A. Durham Dispatch Center shall be notified daily (603-862-1392) prior to blasting to allow notification to municipal agencies. Dispatch shall be notified when blasting activities are completed for each work day.

1.6 REASONABLE PRECAUTIONS

A. Permittee shall take all reasonable precautions, including but not limited to, signage, warning signals, flags, barricades and site watering for dust control, etc.

1. Mats shall be used to cover all blasts.
2. Warning signals to be used are as follows:
   a. 3 Long – 5 minutes to Detonation.
   b. 2 Long – 1 minute to Detonation.
   c. Detonate.
   d. 1 Long – All clear.

1.7 UTILITY PROTECTIONS

   A. Permittee may need to shore up/hold utility poles/make safe with active services when blasting activity is nearby.

   B. Blasting operations are not covered under the standard UNH Dig Safe ticket. UNH Dig Safe must be notified of any and all blasting at the start of the project. The UNH Blasting Ticket must be filled out and submitted to UNH Dig Safe at least five business days in advance of the blasting activity.

1.8 TREE TIP OVER PREVENTIONS

   A. Permittee may need to take precautions to prevent tree top-overs when area trees in shallow earth cover.

END OF SECTION 02318
SECTION 02510 - WATER DISTRIBUTION

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
4. All water used in potable water systems shall adhere to American Water Works Association Standards, as set forth in the AWWA Standards Index.

B. Tracer Wire: Refer to Chapter 5, Division 1, Section 01100 1.3 N. 1 ‘General Requirements.’

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

H. Fire Hydrant installations shall conform with the following:

1. General purpose hydrants shall be spaced within 300 feet of each other in central business, limited business and office and research zones. Space every 800 feet elsewhere.
2. Primary hydrants shall be located no closer than 50 feet nor more than 150 feet from the closest portion of the building they protect.
3. Building hydrants shall be located within 300 feet of any portion of a structure greater than 6,000 feet in area. If not possible, provide standpipes for Durham Fire Department.

4. Locate hydrants as close to Durham Fire Department connections as possible, without being located in the building collapse zone and not more than 75 feet away.

5. Protect hydrants from physical damage when judged necessary by the Durham Fire Department.

6. Locate hydrants within 3 feet of paved road surface capable of withstanding use by fire apparatus.

7. Hydrants shall not be located under power lines or other potentially hazardous locations.

8. All hydrant locations shall be approved by the Durham Fire Department prior to installation.

   a. Hydrants shall be capable of flowing 100gpm at 20 SPIG in residential zones and 1500 gpm at 20 SPIG in Commercial Zones.

   b. Hydrants shall open Left and shall be 6” size

   c. Hydrant colors shall be of reflective paint as follows:

      1) Pressure Hydrants          Barrel- Yellow- Bonnet –White

   d. 20 Discharge caps shall be as follows:

      1) Class AA-(1500+ gpm at 20 PSI)- Light Blue
      2) Class A- (1000-1500gpm at 20 PSI) Green
      3) Class B-(50-1000 gpm at 20 PSI) -Orange
      4) Class C- (Less than 500 gpm at 20 PSI)-Red
      5) Hydrants Less than 20 PSI static and private hydrants-Barrel Red-Bonnet White on private yard Hydrants
      6) Discharge caps shall be color encoded as to maximum water flow capabilities regardless of residual pressures.

1.3 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify University no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without University’s written permission.

1.4 COORDINATION

A. Coordinate connection to water main with utility company.
1.5 PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.


B. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.


C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

E. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:
   a. Manufacturers:
      1) Anvil International, Inc.
      2) Victaulic Company of America.

F. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200.

1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

G. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, Class 150 and Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

1.6 JOINING MATERIALS
A. Brazing Filler Metals: AWS A5.8, BCuP Series.
B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

1.7 PIPING SPECIALTIES
A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
B. Tubular-Sleeve Pipe Couplings:
   1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

1.8 GATE VALVES
A. AWWA, Cast-Iron Gate Valves:
   1. Available Manufacturers:
      d. Crane Co.; Crane Valve Group; Stockham Div.
      e. East Jordan Iron Works, Inc.
2. Nonrising-Stem, Metal-Seated Gate Valves:
   a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
      1) Standard: AWWA C500.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

3. Nonrising-Stem, Resilient-Seated Gate Valves:
   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

4. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
   a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 250 psig (1725 kPa).
      3) End Connections: Push on or mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

5. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
   a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
      1) Standard: AWWA C500.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Flanged.

6. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
   a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. Available Manufacturers:
   c. Crane Co.; Crane Valve Group; Stockham Div.
   d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   e. McWane, Inc.; Kennedy Valve Div.
   f. McWane, Inc.; M & H Valve Company Div.
   g. Mueller Co.; Water Products Div.
   h. NIBCO INC.
   i. U.S. Pipe and Foundry Company.

2. UL/FMG, Nonrising-Stem Gate Valves:
   a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
      1) Standards: UL 262 and FMG approved.
      2) Minimum Pressure Rating: 175 psig (1207 kPa).
      3) End Connections: Flanged.

3. OS&Y, Rising-Stem Gate Valves:
   a. Description: Iron body and bonnet and bronze seating material.
      1) Standards: UL 262 and FMG approved.
      2) Minimum Pressure Rating: 175 psig (1207 kPa).
      3) End Connections: Flanged.

C. Bronze Gate Valves:

1. Available Manufacturers:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Red-White Valve Corporation.

2. OS&Y, Rising-Stem Gate Valves:
   a. Description: Bronze body and bonnet and bronze stem.
3. Nonrising-Stem Gate Valves:
   a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
      1) Standard: MSS SP-80.

1.9 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers:
   b. East Jordan Iron Works, Inc.
   c. Flowserve.
   d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   e. McWane, Inc.; Kennedy Valve Div.
   f. McWane, Inc.; M & H Valve Company Div.
   g. Mueller Co.; Water Products Div.
   h. U.S. Pipe and Foundry Company.

2. Description: Sleeve and valve compatible with drilling machine.
   a. Standard: MSS SP-60.
   b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
   c. Valve: AWWA, cast-iron, nonrising-stem, metal or resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
1.10 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

1. Available Manufacturers:
   a. Amcast Industrial Corporation; Lee Brass Co.
   b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
   c. Jones, James Company.
   d. Master Meter, Inc.
   e. McDonald, A. Y. Mfg. Co.
   f. Mueller Co.; Water Products Div.
   g. Red Hed Manufacturing & Supply.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

1.11 WATER METERS

A. Water meters will be furnished by Contractor and coordinated with UNH.

B. Manufacturers:

1. Available Manufacturers:
   a. Badger Meter, Inc.

1.12 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers:
   a. Beeco
2. Available Manufacturers:
   a. Ames Fire & Waterworks; a division of Watts Regulator Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.

1.13 WATER METER BOXES

1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
   A. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

1.14 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
   1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
   2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
      a. Dimension: 24-inch (610-mm) minimum diameter, unless otherwise indicated.
   3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
      a. Dimension: 24-inch- (610-mm-) minimum diameter, unless otherwise indicated.
   4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

1.15 FIRE HYDRANTS

A. General:
   1. Hydrants shall be capable of flowing 100 GPM at 20 psig in residential zones and 1,500 GPM at 20 psig in commercial (central business, limited business, and office and research) zones as defined in the Town of Durham Zoning Ordinance.
   2. Hydrant valves shall OPEN LEFT and shall be 6 inch SIZE.
   3. Hydrants shall be located 3 feet from edge of sidewalk to prevent winter plow damage.
4. Provide a permanent marking post when required by the authority having jurisdiction.
   a. Pressure Hydrants: Provide yellow posts.
   b. Hydrants providing 1-20 psig: Provide red posts.

B. Hydrant Colors: Provide reflective type paint as follows:

1. Pressure Hydrants:

2. Discharge Caps as follows:
   a. Class AA – (1500 + GPM @ 20 PSI) Light Blue.
   b. Class A – (1000 – 15000 GPM @ 20 PSI) Green.
   c. Class B – (500 – 1000 GPM @ 20 PSI) Orange.
   d. Class C – (Less than 500 GPM @ 20 PSI) Red.

3. Hydrants with less than 20 PSI static and private hydrants:
   c. Private Yard Bonnet: White.

4. Discharge Caps shall be color-coded as to maximum water flow capabilities regardless of residual pressures.

C. Dry-Barrel Fire Hydrants:

1. Available Manufacturers:
   d. American Foundry Group, Inc.
   e. East Jordan Iron Works, Inc.
   f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   g. McWane, Inc.; Kennedy Valve Div.
   h. McWane, Inc.; M & H Valve Company Div.
   i. Mueller Co.; Water Products Div.
   j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
   k. U.S. Pipe and Foundry Company.

2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

3. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

   a. Standards: UL 246, FMG approved.
   b. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
   c. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
   d. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
   e. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

D. Wet-Barrel Fire Hydrants:

1. Available Manufacturers:
   c. McWane, Inc.; Clow Valve Co. Div. (Corona).
   d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   e. Mueller Co.; Water Products Div.

2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550.


3. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet.

   a. Standards: UL 246 and FMG approved.
   b. Pressure Rating: 150 psig (1035 kPa) minimum.
   c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
   d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
   e. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
   f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

1.16 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Available Manufacturers:
b. Fire End & Croker Corporation.
c. Guardian Fire Equipment, Inc.
d. Kidde Fire Fighting.
e. Potter Roemer.
f. Reliable Automatic Sprinkler Co., Inc.

2. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.

b. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) or NPS 6 (DN 150) outlet.
c. Connections: Three or Four NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet.
d. Connections: Six NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) or NPS 8 (DN 200) outlet.

END OF SECTION 02510
SECTION 02515 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

1.1 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and service entrance piping through wall into the building.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation by the contractor.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
   2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.


E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.3 COORDINATION

A. Coordinate connection to water main with utility company.

1.4 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

B. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.

C. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

1.5 DUCTILE-IRON PIPE AND FITTINGS

A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.

D. Grooved-End, Ductile-Iron Pipe Appurtenances:
   1. Manufacturers:
      a. Anvil International, Inc.
      b. Shurjoint Piping Products.
      c. Star Pipe Products.
      d. Victaulic Company.
   3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.


G. Flanges: ASME B16.1, Class 125, cast iron.

1.6 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints:
   1. Manufacturers:
      a. EBAA Iron, Inc.
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

1.7 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density PE film of 0.008-inch (0.20-mm) or High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

1.8 JOINING MATERIALS

A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

1.9 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers:
   a. Cascade Waterworks Manufacturing.
   b. Dresser, Inc.; Dresser Piping Specialties.
   c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
   d. JCM Industries.
   e. ROMAC Industries Inc.
   f. Smith-Blair, Inc.; a Sensus company.
   g. Viking Johnson.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
1.10 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

1. Amcast Industrial Corporation.
2. Ford Meter Box Company, Inc. (The); Pipe Products Division.
4. Master Meter, Inc.

B. Corporation Valves: Comply with AWWA C800. Include saddle and valve compatible with tapping machine and manifold.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800 for high-pressure service-line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.

D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.

1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

E. Meter Valves: Comply with AWWA C800 for high-pressure service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

1.11 GATE VALVES

A. AWWA Gate Valves:

1. Manufacturers:

   a. American AVK Company; Valves & Fittings Division.
   b. American Cast Iron Pipe Company; American Flow Control Division.
   c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   d. American R/D.
   e. Clow Valve Company; a division of McWane, Inc.
   f. Crane Co.; Crane Valve Group; Stockham Division.
g. East Jordan Iron Works, Inc.

h. Kennedy Valve; a division of McWane, Inc.

i. M&H Valve Company; a division of McWane, Inc.

j. Mueller Co.; Water Products Division.

k. NIBCO Inc.

l. Tyler Pipe; a division of McWane, Inc.; Utilities Division.

m. U.S. Pipe.

2. 200-psig (1380-kPa), AWWA, Iron, Nonrising-Stem, Metal-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.


c. Pressure Rating: 200 psig (1380 kPa).

d. End Connections: Mechanical joint.

e. Interior Coating: Complying with AWWA C550.

3. 200-psig (1380-kPa), AWWA, Iron, Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.


c. Pressure Rating: 200 psig (1380 kPa).

d. End Connections: Mechanical or push-on joint.

e. Interior Coating: Complying with AWWA C550.

4. 200-psig (1380-kPa), AWWA, Iron, OS&Y, Metal-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet; with cast-iron double disc, bronze disc and seat rings, and bronze stem.


c. Pressure Rating: 200 psig (1380 kPa).

d. End Connections: Flanged or grooved.

5. 200-psig (1380-kPa), AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.


c. Pressure Rating: 200 psig (1380 kPa).

d. End Connections: Flanged or grooved.

6. Class 125, Bronze, Nonrising-Stem Gate Valves:

a. Description: Class 125, Type 1; bronze with solid wedge and malleable-iron handwheel.


c. Pressure Rating: 200 psig (1380 kPa).

d. End Connections: Solder joint or threaded.
B. UL-Listed or FM-Approved Gate Valves:

1. Manufacturers:
   a. American AVK Company; Valve & Fittings Division.
   b. American Cast Iron Pipe Company; American Flow Control Division.
   c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. East Jordan Iron Works, Inc.
   h. Hammond Valve.
   i. Kennedy Valve; a division of McWane, Inc.
   j. M&H Valve Company; a division of McWane, Inc.
   k. Milwaukee Valve Company.
   l. Mueller Co.; Water Products Division.
   m. NIBCO INC.
   n. Shurjoint Piping Products.
   o. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
   p. Tyco Fire & Building Products LP.
   q. United Brass Works, Inc.
   r. U.S. Pipe.
   s. Watts Water Technologies, Inc.

2. 175-psig (1200-kPa), UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
   a. Description: Iron body and bonnet, bronze seating material, and inside screw.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. End Connections: Mechanical or push-on joint.
   e. Indicator-Post Flange: Include on valves used with indicator posts.

3. 175-psig (1200-kPa), UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
   a. Description: Iron body and bonnet and bronze seating material.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. End Connections: Flanged or grooved.

4. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Crane Co.; Crane Valve Group; Crane Valves.
      2) Crane Co.; Crane Valve Group; Stockham Division.
      3) Milwaukee Valve Company.
      4) NIBCO INC.
5) United Brass Works, Inc.

b. Description: Bronze body and bonnet and bronze stem.
d. Pressure Rating: 175 psig (1200 kPa) minimum.
e. End Connections: Threaded.

1.12 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. Clow Valve Company; a division of McWane, Inc.
   c. East Jordan Iron Works, Inc.
   d. Flowserve.
   e. Kennedy Valve; a division of McWane, Inc.
   f. M&H Valve Company; a division of McWane, Inc.
   g. Mueller Co.; Water Products Division.
   h. U.S. Pipe.

2. Description: Sleeve and valve compatible with drilling machine.
4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
5. Valve: AWWA, cast-iron, nonrising-stem, metal or resilient-seated gate valve with one raised-face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts:

1. Manufacturers:
   a. American AVK Company; Valves & Fittings Division.
   b. American Cast Iron Pipe Company; American Flow Control Division.
   c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Stockham Division.
   f. Kennedy Valve; a division of McWane, Inc.
   g. Mueller Co.; Water Products Division.
h. NIBCO INC.
  i. Tyco Fire & Building Products LP.

2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

1.13 WATER METERS

A. Water meters will be furnished by the Contractor.

B. Manufacturers:
   1. Badger Meter, Inc.

C. Displacement-Type Water Meters:
   1. Description: With bronze main case.

D. Compound-Type Water Meters:
   2. Registration: Flow in gallons (liters).

E. Remote Registration System:
   1. Description: Utility company’s standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

F. Remote Registration System:
   1. Description: Utility company’s standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
   4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
   5. Visible Display Units: Comply with utility company's requirements for type and quantity.
1.14 WATER METER BOXES

A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" on cover; and with slotted, open-bottom base section of length to fit over service piping.

1. Option: Base section may be cast-iron, PVC, clay, or other pipe.

1.15 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857, and made according to ASTM C 858.

B. Ladder: ASTM A 36/A 36M, steel ladder; or PE-encased steel steps.

C. Manhole: ASTM A 48/A 48M, Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

1. Dimension: 24-inch (610-mm) minimum diameter unless otherwise indicated.

D. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.

1. Dimension: 24-inch (610-mm) minimum diameter unless otherwise indicated.

E. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

1.16 FIRE HYDRANTS

A. AWWA Dry-Barrel Fire Hydrants:

1. Manufacturers:
   a. American AVK Company; Valves & Fittings Division.
   b. American Cast Iron Pipe Company; American Flow Control Division.
   c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   d. American Foundry Group, Inc.
   e. Clow Valve Company; a division of McWane, Inc.
   g. Kennedy Valve; a division of McWane, Inc.
   h. M&H Valve Company; a division of McWane, Inc.
   i. Mueller Co.; Water Products Division.
   j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
   k. U.S. Pipe.

2. Description: Post type, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets; and with 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to
AWWA C550. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.

4. Pressure Rating: 150 psig (1035 kPa) minimum or 200 psig (1380 kPa) minimum.

B. UL-Listed, Dry-Barrel Fire Hydrants:

1. Manufacturers:
   a. American Cast Iron Pipe Company; American Flow Control Division.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. American Foundry Group, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. East Jordan Iron Works, Inc.
   f. Kennedy Valve; a division of McWane, Inc.
   g. M&H Valve Company; a division of McWane, Inc.
   h. Mueller Co.; Water Products Division.
   i. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
   j. U.S. Pipe.

2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets; and with 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.
5. Pressure Rating: 150 psig (1035 kPa) minimum, 175 psig (1200 kPa) minimum, or 200 psig (1380 kPa) minimum.
6. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
7. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
8. Direction of Opening: Hydrant valve opens by turning operating nut to left or counterclockwise.

C. AWWA Wet-Barrel Fire Hydrants:

1. Manufacturers:
   a. American AVK Company; Valves & Fittings Division.
   b. Clow Valve Company; a division of McWane, Inc.
   c. Jones, James Company.
   d. Mueller Co.; Water Products Division.

2. Description: Post type, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets and with NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550.
4. Pressure Rating: 150 psig (1035 kPa) minimum, 200 psig (1380 kPa) minimum, or 250 psig (1725 kPa).

D. UL-Listed, Wet-Barrel Fire Hydrants:

1. Manufacturers:
   a. American AVK Company; Valves & Fittings Division.
   b. Clow Valve Company; a division of McWane, Inc.
   c. Jones, James Company.
   d. Mueller Co.; Water Products Division.

2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets and with NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet.


5. Pressure Rating: 150 psig (1035 kPa) minimum, 175 psig (1200 kPa) minimum, or 200 psig (1380 kPa)

6. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.

7. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.

8. Direction of Opening: Hydrant valves open by turning operating nut to left or counterclockwise.


1.17 FIRE-DEPARTMENT CONNECTIONS

A. Manufacturers:

2. Fire-End & Croker Corporation.
5. Potter Roemer.
6. Reliable Automatic Sprinkler Co., Inc.

B. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire-department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.

C. Standard: UL 405.

D. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) or NPS 6 (DN 150) outlet.

E. Connections: Three or Four NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet.
F. Connections: Six NPS 2-1/2 (DN 65) inlets and one NPS 6 (DN 150) outlet.

G. Inlet Alignment: Inline, horizontal or square.

H. Finish Including Sleeve: Polished chrome plated, Rough chrome plated, or Polished bronze.

I. Escutcheon Plate Marking: "AUTO SPKR & STANPIPE."

1.18 ALARM DEVICES

A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

END OF SECTION 02515
SECTION 02530 - SANITARY SEWERAGE

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints.
5. Encasement for piping.
7. Tracer Wire: Refer to Chapter 5, Division 01100 1.3 N. 1 ‘General Requirements.’

1.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes and Extra-Heavy class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

1.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI-Trademark, Shielded Couplings:

1. Manufacturers:

   a. ANACO-Husky.
   c. Fernco Inc.
   d. Mission Rubber Company; a division of MCP Industries, Inc.
   e. Stant; a Tompkins company.
   f. Tyler Pipe.

2. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Shielded Couplings:

1. Manufacturers:

   a. ANACO-Husky.
   b. Clamp-All Corp.
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. Stant; a Tompkins company.
f. Tyler Pipe.

2. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

1.4 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:
   2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.

B. PVC Type PSM Sewer Piping:
   1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM D 3034, PVC with bell ends.

1.5 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14 (ASTM C 14M).

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1.6 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   2. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
   3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1.7 EXPANSION JOINTS

A. Ductile-Iron, Flexible Expansion Joints:

1. Manufacturers:
   a. EBAA Iron, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.

2. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig (1725-kPa) minimum working pressure and for offset and expansion indicated.

1.8 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty and Extra-Heavy Duty.

2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

1.9 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105.

B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) or high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

1.10 MANHOLES

A. Standard Precast Concrete Manholes:
1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.

3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.

4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.

5. Riser Sections: 4-inch (100-mm) minimum thickness, of length to provide depth indicated.

6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.


8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.

9. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).

10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

1.11 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
2. Benches: Concrete, sloped to drain into channel.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

END OF SECTION 02530
SECTION 02532 - PACKAGED SEWAGE PUMPING STATIONS

1.1 SUMMARY
A. This Section includes wet-well, packaged pumping stations with submersible and submersible grinder sewage pumps.

1.2 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3 WET-WELL, PACKAGED SEWAGE PUMPING STATIONS
A. Wet-Well, Packaged Sewage Pumping Stations with Submersible Sewage Pumps:
1. Available Manufacturers:
   a. Gorman-Rupp Company (The).
   b. Metropolitan Industries, Inc.
   c. PumpTech, Inc.
   d. USEMCO.
   e. Yeomans Chicago Corporation.
2. Description: Factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with sewage pumps and dry equipment chamber for controls and accessories.

B. Wet-Well, Packaged Sewage Pumping Stations with Submersible Grinder Sewage Pumps:
1. Available Manufacturers:
   a. Environment One Corporation.
   b. Gorman-Rupp Company (The).
   c. Pentair Pump Group; F. E. Myers.
   d. PumpTech, Inc.
   e. USEMCO.
2. Description: Factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with dry equipment chamber for controls and accessories.

1.4 CONTROLS

A. Control Sequence of Operation: Cycle each sewage pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag sewage pumps at completion of each pumping cycle.

B. Electrode, Float-Switch, Pressure-Switch, or Ultrasonic System: Senses variations of sewage level in wet well. Include high and low adjustments capable of operating on 6-inch (150-mm) minimum differential of liquid level. Alarm circuit shall be wired to UNH Dispatch.

C. Motor Controllers: Magnetic, full voltage, nonreversing. Include undervoltage release, thermal-overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.

D. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.

E. Control Panel: Enclosure complying with UL 508A and with UL 508A, Supplement SB with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

F. Install labels on panel face to identify switches and controls.

G. Wiring: Tin-copper wiring.

H. Connection for Portable Generator: Nonautomatic (manual) transfer switch with receptacle matching generator electrical power requirements.

1.5 ACCESSORIES

A. Lighting: Minimum of 2, UL 1571, heavy-duty, cast-metal, wet-location-type fixtures with 27 Watt CFLS lamps and guards in service area. Locate switches, with pilot lights, at chamber entrance.

B. Submersible Sump Pump:
   2. Pump End Bell and Motor Shell: Cast iron.
5. Shaft: Stainless steel.
7. Seals: Mechanical.
8. Accessories: Inlet strainer.

C. Dehumidifier: Electric refrigeration system, adjustable humidistat, reverse-acting thermostat for low-temperature cutoff controls, and condensate pump with drain piping to sump.

1. Dehumidification system capacity adequate to remove at least 15 pints (7 L) of water per day from service area air that is 80 deg F (27 deg C) with a relative humidity of 60 percent.

D. Ventilation: Electrically powered ventilation system. Include centrifugal blower with 4-inch- (100-mm-) round exhaust vent designed to keep out rain, insects, and other foreign matter; limit switch to start blower if entrance door or lid is opened; 0- to 15-minute timer; and separate manual switch.

1. Ventilating system capacity to change air in dry equipment chamber every two minutes.

E. Heater: Electric, 1.5 kW minimum, with fan and thermostat control.

F. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by separate level-detecting device. Include alarm silencer switch and relay in station.

G. Remote Alarm Circuit: Include contacts for connection to remote alarm wired to UNH Dispatch.

1.6 PACKAGED SEWAGE PUMPING STATION FABRICATION

A. Fabricate shell from fiberglass with structural-steel reinforcement.

1. Attach structural-steel reinforcement to top and bottom heads.
2. Fabricate shell with continuous joints to make watertight and gastight construction.
3. Attach air vent to pump chamber and entrance tube.
4. Ladder: Steel or Fiberglass.

B. Install sump, 18 inches (450 mm) in diameter by 10 inches (254 mm) deep in dry-chamber floor. Slope floor toward sump and fasten rubber mat to floor walkway with cement.

C. Entrance tube may be furnished separately for field installation.

D. Entrance Cover: Waterproof and corrosion resistant, with lock. Include way to open cover from inside tube if cover is locked.
E. Air Vent: Duct fabricated from corrosion-resistant material, extended to above grade, outlet turned down, and with insect screen in outlet.

F. Factory fabricate piping between unit components.
   1. Use galvanized-steel pipe and cast-iron fittings or ductile-iron pipe and fittings.
   2. Use fittings for changes in direction and branch connections.
   3. Flanged and union joints may be used instead of joints specified.
   4. Use dielectric fittings for connections between ferrous- and copper-alloy piping.

G. Piping Connections: Unless otherwise indicated, make the following piping connections:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having NPS 2 (DN 50) or smaller threaded pipe connection.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

H. Valves: Ferrous alloy.
   1. Sewage Pump Piping: Include gate valve on each pump inlet and gate and check valves on each discharge pipe.
   2. Sump Pump Piping: Include ball or gate and check valves on discharge pipe.

I. Wiring: Tin-coated copper.

1.7 SOURC E QUALITY CONTROL

A. Test and inspect sewage and sump pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, suction lift, speed, and horsepower.

B. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.
SECTION 02540 - SEPTIC TANK SYSTEMS

1.1 SUMMARY

A. Section Includes:
   1. Septic tanks.
   2. Distribution boxes.
   3. Pipe and fittings.
   4. Absorption systems.

1.2 CONCRETE SEPTIC TANKS

A. Description: ASTM C 1227, precast, reinforced-concrete tank and covers; single chamber, single chamber with internal baffle, or two chambers.

B. Design: For A-8 (H10-44), A-12 (HS15-44), or A-16 (HS20-44) traffic loading according to ASTM C 890.

C. Manholes: 24-inch- (610-mm-) minimum diameter opening with reinforced-concrete risers to grade and access lid with steel lift rings. Include manhole in center of each septic tank compartment top.

D. Filter Access: Reinforced-concrete access hole, large enough to remove filter, over filter position.

E. Inlet and Outlet Access: 12-inch (305-mm) minimum diameter, reinforced-concrete access lids with steel lift rings. Include access centered over inlet and outlet.

F. Resilient Connectors: ASTM C 923 (ASTM C 923M), of size required for piping, fitted into inlet and outlet openings.

1.3 POLYETHYLENE SEPTIC TANKS

A. Manufacturers:
   2. Norwesco, Inc.
   4. Premier Plastics Ltd.

B. Description: Molded, HDPE or PE construction; fabricated for septic tank application; single chamber, single chamber with baffle and at least one access riser and manhole, or two chambers each with an access riser and manhole.

C. Manholes: 18-inch- (457-mm-), 20-inch- (508-mm-), or 22-inch- (559-mm-) minimum diameter opening with HDPE or PE access risers to grade and cover.
D. Filter Access: Include access hole, large enough to remove filter, over filter position.

E. Resilient Connectors: ASTM C 923 (ASTM C 923M) or other watertight seal, of size required for piping, fitted into inlet and outlet openings.

1.4 FILTERS

A. Manufacturers:
   2. Tuf-Tite Corporation.

B. Description: Removable, septic-tank-outlet filter that restricts discharge solids to 1/8 inch (3.2 mm).

C. Housing: HDPE or PVC.

D. Outlet Size: NPS 4 (DN 100) or NPS 6 (DN 150).

1.5 CONCRETE DISTRIBUTION BOXES

A. Description: Precast concrete, single-chamber box and cover.

B. Design: Made according to ASTM C 913, and for A-8 (H10-44), A-12 (HS15-44), or A-16 (HS20-44) traffic loading according to ASTM C 890. Include baffle opposite inlet.

C. Manholes: 20-inch- (508-mm-), 22-inch- (559-mm-), or 24-inch- (610-mm-) minimum diameter opening with reinforced-concrete risers to grade and cover with steel lift rings in center of distribution box cover.

D. Resilient Connectors: ASTM C 923 (ASTM C 923M), of size required for piping, fitted into inlet and outlet openings. Include watertight plugs in outlets not required.

1.6 PE DISTRIBUTION PIPE AND FITTINGS

A. Tube and Fittings: ASTM F 405, perforated corrugated tube with solid-wall fittings.

B. Couplings: PE band, matching tube and fitting dimensions.

1.7 NONPRESSURE PIPE COUPLINGS

A. Description: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, with corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Sleeve Materials for Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
2. Sleeve Materials for Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

1.8 TRENCH OR BED ABSORPTION-SYSTEM MATERIALS

A. Filter Material: ASTM D 448, Size No. 24, 3/4 to 2-1/2 inches (19 to 63 mm), washed, crushed stone or gravel; or broken, hard-burned clay brick.

B. Filter Mat: Geotextile woven or spun filter fabric, in one or more layers, for minimum total unit weight of 3 oz./sq. yd. (101 g/sq. m) or untreated building paper or similar porous material.

C. Cover for Distribution Pipe: Geotextile woven filter fabric, in one or more layers, for minimum total unit weight of 3 oz./sq. yd. (101 g/sq. m).

D. Fill Material: Soil removed from trench.

END OF SECTION 02540
SECTION 02551 - UNDERGROUND HYDRONIC PIPING

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipes and fittings.
3. Ductile-iron pipe and fittings.
4. Plastic pipe and fittings.
5. Transition fittings.
6. Conduit piping system.
7. Cased piping system.

1.2 QUALITY ASSURANCE


1.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) or ASTM B 88, Type M (ASTM B 88M, Type C).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

1.4 STEEL PIPES AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black or galvanized with plain ends; type, grade, and wall thickness as indicated in "Piping Application" Article.

B. Cast-Iron, Threaded Fittings: ASME B16.4; Class 125 and Class 250.


D. Malleable-Iron Unions: ASME B16.39; Class 150, Class 250, and Class 300.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 125 and Class 250; raised ground face, and bolt holes spot faced.
F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Welding Fittings: ASME B16.9 and ASTM A 234/A 234M, seamless or welded.


I. Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

J. Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

K. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and -bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

L. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

1.5 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end.

   a. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

1.6 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic:
1. Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in "Piping Application" Article.
   a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. PVC Plastic:
1. Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in "Piping Application" Article.
   a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

1.7 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cemented-joint end.

1.8 CONDUIT PIPING SYSTEM

A. Description: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping with conduit, inner pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit.

1. Manufacturers:
   a. Insul-Tek Piping Systems, Inc.
   b. Perma-Pipe, Inc.
   c. Rovanco Piping Systems, Inc.
   d. Thermacor Process, L.P.

B. Carrier Pipe Insulation:
1. Mineral-Wool Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, 850 deg F (454 deg C) or Type II, 1200 deg F (649 deg C), Grade A.
   a. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch (19 mm) wide, 0.020 inch (0.5 mm) thick.

2. Calcium Silicate Pipe Insulation: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
   a. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch (19 mm) wide, 0.020 inch (0.5 mm) thick.

   a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
   b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
   c. Fabricate shapes according to ASTM C 450 and ASTM C 585.

   a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
   b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
   c. Fabricate shapes according to ASTM C 450 and ASTM C 585.

C. Minimum Clearance:
   1. Between Carrier Pipe Insulation and Conduit: 1 inch (25 mm).
   2. Between Insulation of Multiple Carrier Pipes: 3/16 inch (4.75 mm).
   3. Between Bottom of Carrier Pipe Insulation and Conduit: 1 inch (25 mm).
   4. Between Bottom of Bare, Carrier Pipe and Casing: 1-3/8 inches (35 mm).

D. Conduit: Spiral wound, steel.
   2. Piping Supports within Conduit: Corrugated galvanized steel with a maximum spacing of 10 feet (3 m).
3. Fittings: Factory-fabricated and -insulated elbows and tees. Elbows may be bent pipe equal to carrier pipe. Tees shall be factory fabricated and insulated, and shall be compatible with the carrier pipe.

4. Expansion Offsets and Loops: Size casing to contain piping expansion.

5. Accessories include the following:

   a. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches (75 mm) deep and 2 inches (50 mm) larger than casing; terminate casing 20 inches (500 mm) above the floor level.
   
   b. Guides and Anchors: Steel plate welded to carrier pipes and to casing, complete with vent and drainage openings inside casing.
   
   c. End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline.
   
   d. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of casing, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.
   
   e. Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.

E. Manholes: Black steel with lifting eyes.

   1. Finish: Spray-applied urethane, minimum 30 mils (0.75 mm) thick.
   
   2. Access: 30-inch- (750-mm-) diameter waterproof cover with gasket, ladder, and two 6-inch (150-mm) vents, one high and one low, extending above grade with rain caps.
   
   
   4. Sump: 12 inches (300 mm) in diameter, 12 inches (300 mm) deep.
   
   5. Floatation Anchor: Oversized bottom keyed into concrete base.

F. Source Quality Control: Factory test conduit to 15 psig (105 kPa) for a minimum of two minutes with no change in pressure. Factory test carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

1.9 CASED PIPING SYSTEM

A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

   1. Manufacturers:

      a. Insul-Tek Piping Systems, Inc.
      b. Perma-Pipe, Inc.
      c. Rovanco Piping Systems, Inc.
      d. Thermacor Process, L.P.
      e. Thermal Pipe Systems.
      f. Urecon Ltd.

B. Carrier Pipe Insulation:

   1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F (0.020 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.

C. Casing accessories include the following:

1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.

D. Manholes: Black steel with lifting eyes.

1. Finish: Spray-applied urethane, minimum 30 mils (0.75 mm) thick.
2. Access: 30-inch- (750-mm-) diameter waterproof cover with gasket, ladder, and two 6-inch (150-mm) vents, one high and one low, extending above grade with rain caps.
4. Sump: 12 inches (300 mm) in diameter, 12 inches (300 mm) deep.
5. Floatation Anchor: Oversized bottom keyed into concrete base.

E. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

END OF SECTION 02551
SECTION 02555 - STEAM DISTRIBUTION

1.1 SUMMARY

A. Section includes underground piping outside the building for distribution of steam and condensate.

1.2 QUALITY ASSURANCE


B. ASME Compliance: Safety valves and pressure vessels shall bear appropriate ASME labels.

C. Tracer Wire: Refer to Chapter 5, Division 1 Section 01100 1.3 N. 1 ‘General Requirements.’

1.3 STEEL PIPES AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E, Grade A, wall thickness as indicated in "Piping Application" Article; black with plain ends.

B. Cast-Iron, Threaded Fittings: ASME B16.4, Class 125 and Class 250, standard pattern, with threads according to ASME B1.20.1.

C. Malleable-Iron, Threaded Fittings: ASME B16.3, Class 150 and Class 300, with threads according to ASME B1.20.1.

D. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.

E. Steel Welding Fittings: ASME B16.9 and ASTM A 234/A 234M, seamless or welded.

F. Nipples: ASTM A 733, Standard Weight, seamless, carbon-steel pipe complying with ASTM A 53/A 53M.

G. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

H. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

1.4 CONDUIT PIPING SYSTEM

A. Conduit Piping System: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping with conduit, inner pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit.

1. Manufacturers:
   a. Insul-Tek Piping Systems, Inc.
   b. Perma-Pipe, Inc.
   c. Rovanco Piping Systems, Inc.
   d. Thermacor Process, L.P.

B. Carrier Pipe: Steel pipe and fittings.

C. Carrier Pipe Insulation:

1. Mineral-Wool Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, 850 deg F (454 deg C) or Type II, 1200 deg F (649 deg C), Grade A.
   a. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch (19 mm) wide, 0.020 inch (0.5 mm) thick.

2. Calcium Silicate Pipe Insulation: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
   a. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch (19 mm) wide, 0.020 inch (0.5 mm) thick.

   a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
   b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
c. Fabricate shapes according to ASTM C 450 and ASTM C 585.

   a. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
   b. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
   c. Fabricate shapes according to ASTM C 450 and ASTM C 585.

D. Minimum Clearance:
   1. Between Carrier Pipe Insulation and Conduit: 1 inch (25 mm).
   2. Between Insulation of Multiple Carrier Pipes: 3/16 inch (4.75 mm).
   3. Between Bottom of Carrier Pipe Insulation and Conduit: 1 inch (25 mm).

E. Conduit: Spiral wound, steel.
   2. Piping Supports within Conduit: Corrugated galvanized steel with a maximum spacing of 10 feet (3 m).
   3. Fittings: Factory-fabricated and insulated elbows and tees. Elbows may be bent pipe equal to carrier pipe. Tees shall be factory fabricated and insulated, and shall be compatible with the carrier pipe.
   4. Expansion Offsets and Loops: Size casing to contain piping expansion.
   5. Accessories include the following:
      a. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches (75 mm) deep and 2 inches (50 mm) larger than casing; terminate casing 20 inches (500 mm) above the floor level.
      b. Guides and Anchors: Steel plate welded to carrier pipes and to casing, complete with vent and drainage openings inside casing.
      c. End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline.
      d. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of casing, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.
      e. Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.

F. Manholes: Black steel with lifting eyes.
   1. Finish: Spray-applied urethane, minimum 30 mils (0.75 mm) thick.
   2. Access: 30-inch- (750-mm-) diameter waterproof cover with gasket, ladder, and two 6-inch (150-mm) vents, one high and one low, extending above grade with rain caps.
   4. Sump: 12 inches (300 mm) in diameter, 12 inches (300 mm) deep.
5. Floatation Anchor: Oversized bottom keyed into concrete base.

G. Source Quality Control: Factory test the conduit to 15 psig (105 kPa) for a minimum of two minutes with no change in pressure. Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

END OF SECTION 02555
SECTION 02584 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

1.1 SUMMARY

A. Section Includes:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and pull boxes.
   4. Tracer Wire: Refer to Chapter 5, Division 1, Section 01100 1.3 N. 1 ‘General Requirements.’

1.2 QUALITY ASSURANCE

A. Comply with IEEE C2.
B. Comply with NFPA 70.

1.3 CONDUIT

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

1.4 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers:
   1. AFC Cable Systems.
   2. ARNCO Corporation.
   4. Cantex, Inc.
   5. CertainTeed Corp.
   7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
   8. Electri-Flex Company.
   9. IPEX Inc.
   10. Lamson & Sessions; Carlon Electrical Products.
   11. Manhattan Wire Products; a Belden company.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and retained to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
   b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

1.5 HANDHOLES AND PULL BOXES

A. Description: Comply with SCTE 77.
   1. Color: Gray or Green.
   2. Configuration: Units shall be designed for flush burial and have open, closed, or integral closed bottom unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering.
   7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Fiberglass Handholes and Pull Boxes with Polymer Concrete Frame and Cover: Complying with SCTE 77 Tier 5, Tier 8, or Tier 15 loading. Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
   1. Manufacturers:
      a. Armorcast Products Company.
      b. Carson Industries LLC.
      c. Christy Concrete Products.
      d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

1.6 PRECAST MANHOLES

A. Manufacturers:
   1. Christy Concrete Products.
   2. Cretex Concrete Products West, Inc.; Riverton Division.
   3. Elmhurst-Chicago Stone Co.
   5. Oldcastle Precast Inc.; Utility Vault Division.
   6. Utility Concrete Products, LLC.
7. Wausau Tile Inc.

8. Manhole Structure Manholes shall have a minimum internal dimension of 12'-0" by 6'-0' with minimum headroom of 7'.
   a. Shall be for heavy duty precast reinforced concrete manholes for electric installation. The concrete minimum compressive strength: 5000psi at 28 days in accordance with ASTM, reinforced in accordance with H-20 Loading.
   b. Precast units shall not have more than two (2) sections
   c. Provide Precase extension with mortared joints with full bearing.
   d. Joints between sections shall have self-aligning V-grooves and asphaltic butyl compound joint sealant.
   e. All conduits shall be terminated in termaduct fittings precast into the manhole walls.
   f. All concrete ducts shall be doveled to the manhole walls and building foundation walls with rebar.
   g. Frames and covers shall be cast iron, heavy-duty type, suitable for H-20 street loading and have machined bearing surfaces. Electrical manholes shall have a minimum clear opening of 32" in diameter. The word “Electrical” shall be cast on the upper side of each cover.

9. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
   a. Type and size shall match fittings to duct or conduit to be terminated.
   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

B. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

C. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

D. Manhole exterior walls, roofs, bottom and the first 10' porting of ductbank entering and leaving the manhole shall be waterproof coated with coal tar epoxy bitumastic.

1.7 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers:
   1. Bilco Company (The).
   2. Campbell Foundry Company.
   3. Christy Concrete Products.
   4. Cretex Concrete Products West, Inc.; Riverton Division.
   7. Hubbell Power Systems; Lenoir City Division.
15. Underground Devices, Inc.
16. Utility Concrete Products, LLC.
17. Wausau Tile Inc.

B. Ferrous metal hardware, where indicated, shall be hot-dip galvanized complying with ASTM A 153 (ASTM A 153M) and ASTM A 123 (ASTM A 123M).

C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B or cast aluminum with milled cover-to-frame bearing surfaces; diameter, 32'
   a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Retained to suit system.
   a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
   b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
   c. Legend: "SIGNAL" for communications, data, and telephone duct systems.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387/C 387M, Type M, may be used.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-(50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
   1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.
F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

I. Cable Rack Assembly: Steel, hot-rolled or hot-dip galvanized except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.

2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.


J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

K. Grounding: Provide a complete ground grid around each manhole consisting of (4) 5/8-inch by 8’0” long ground rods located at each corner of the manhole. Interconnect ground rods with #4/0 AWG Bare Stranded Copper Wire looped around the exterior of the manhole. All connections below grade shall be exothermic welded type. A #4/0 AWG Bare Stranded Copper Wire lead shall be brought into the manhole and connected to a #4/0 AWG Bare Stranded Copper Wire looped around the interior perimeter of the manhole and securely attached at 2’ intervals to the wall of the manhole at an elevation of 5’. Connections on the interior of the manhole shall be made by properly sized/rated split bolt connectors or properly sized/rated one bolt connectors.

END OF SECTION 02584
SECTION 02585 – DUCTBANK

1.1 SUMMARY

A. All concrete used for the ductbank shall be 3500 Psi mix minimum. Refer to Chapter 5, Division 3, Section 03300 for LEED requirements.

B. All underground concrete encased conduits shall be PVC, Carlon P & C EB20

C. All conduits entering buildings extending out 10’ from a foundation wall shall be rigid galvanized steel, provide plastic to steel adapter fittings.

D. Elbows and offsets greater than 30 degrees shall be rigid galvanized steel, provide plastic to steel adapter fittings.

E. Conduits shall be placed on spacers 8-1/2” on center, spaced 10’ apart down the trench line. Carlon High Impact Spacers or equal may be used.

F. Underground duct banks shall be set at a minimum depth of 30” below finish grade.

G. All underground Medium/High Voltage ducts shall be encased by reinforced concrete.

H. Reinforcing steel shall be interfaced with the manhole walls and the building foundation walls to minimize shearing. All concrete duct banks shall be doweled to the manholes walls and building foundation walls with rebar.

I. All underground ductbanks shall be field coordinated with existing underground utilities.

1.2 QUALITY ASSURANCE

A. All encased rigid galvanized steel conduit shall be coated with two coats of an asphaltic composition and allowed to dry prior to being encased.

B. The first ten feet of a ductbank either entering or leaving a manhole shall be coated with two coats of an asphaltic composition on the top and sidewalls and allowed to dry prior to being backfilled.

C. All underground conduit runs shall be cleared of all debris by using appropriately sizes brushes/swab pulled from one end of the conduit run to the other end of the conduit run, this operation will be observed by a UNH Rep.

D. All underground conduit runs shall be proof tested for size by pulling a full size mandrel from one end of the conduit run to the other end of the conduit run, this operation will be observed by a University representative.
E. All spare underground conduit runs shall have a nylon pull string installed in each conduit the pull string shall be rated at a minimum tinsel strength or 200 pounds the pull string shall tied off at each end of the conduit run.
UNDERGROUND CONDUIT/DUCTBANK NOTES:

1. RE-BAR DETAIL FOR DUCTBANK SECTION.
2. ALL CONCRETE USED FOR THE DUCTBANK SHALL COMPLY WITH THE SPECIFICATIONS AND SHALL BE 3500 P.S.I. MIX MINIMUM.
4. ALL CONDUIT ENTERING BUILDING’S EXTENDING OUT 10’-0” FROM A FOUNDATION WALL SHALL BE RIGID GALVANIZED STEEL.
5. ELBOWS AND OFFSETS GREATER THAN 30 DEGREES SHALL BE RIGID GALVANIZED STEEL. PROVIDE STEEL TO PLASTIC ADAPTER FITTINGS.
6. CONDUITS SHALL BE PLACED ON CARLON HIGH IMPACT SPACERS 8-1/2” ON CENTER, SPACED 10’ APART DOWN THE TRENCH LINE.
7. UNDERGROUND DUCTBANKS SHALL BE SET A MINIMUM DEPTH OF 30” BELOW GRADE.
8. ALL UNDERGROUND DUCTS SHALL BE ENCASED BY REINFORCED CONCRETE AS INDICATED ON THE DRAWING.
9. REINFORCING STEEL SHALL BE INTERFACED WITH THE MANHOLE WALLS AND THE BUILDING FOUNDATION WALLS TO MINIMIZE SHEARING.
10. ALL UNDERGROUND DUCTBANKS SHALL BE FIELD COORDINATED WITH EXISTING UNDERGROUND UTILITIES.
11. ALL ENCASED RIGID GALVANIZED STEEL CONDUIT SHALL BE COATED WITH TWO COATS OF AN ASPHALTIC COMPOSITION AND ALLOWED TO DRY PRIOR TO BEING ENCASED.
12. THE FIRST TEN FEET OF THE DUCTBANK EITHER ENTERING OR LEAVING A MANHOLE SHALL BE COATED WITH TWO COATS OF AN ASPHALTIC COMPOSITION OF THE TOP AND SIDE WALLS AND ALLOWED TO DRY PRIOR TO BACKFILL.

TYPICAL DUCTBANK RUN TO RISER POLE OR TO PAD MOUNTED TRANSFORMER. MIN. SIZE CONDUIT 5’
GENERAL NOTES:
1. All holes shall be cored to the size recommended by the manufacturer of the conduit sealing bushing.
Exhibit #3

YELLOW PLASTIC WARNING TAPE METALLIC LABELED "HIGH VOLTAGE"
FINISHED GRADE

CONCRETE (WITH RED DYE RAKED INTO TOP 2") BY GENERAL CONTRACTOR, MINIMUM 3500 PSI TEST

#4 RE-BAR Ø24" O.C. WRAPPING DUCTBANK WITH 1-1/2" CONCRETE COVER MINIMUM

CONDUIT SPACERS, 10'-0" O.C.

#5 RE-BAR CONTINUOUS ("YP") WITH 1-1/2" CONCRETE COVER MINIMUM

COMPACTED BACKFILL

1 5" PVC -
2 5" PVC -
UNDERGROUND CONDUIT/DUCTBANK NOTES:
1.) RE-BAR DETAIL FOR DUCTBANK SECTION.
2.) ALL CONCRETE USED FOR THE DUCTBANK SHALL COMPLY WITH THE SPECIFICATIONS AND SHALL BE 3500 P.S.I. MIX MINIMUM.
3.) ALL UNDERGROUND CONDUITS SHALL BE FVC CARLON P & C SERIES EB20.
4.) ALL CONDUIT ENTERING BUILDING'S EXTENDING OUT 10'-0" FROM A FOUNDATION WALL SHALL BE RIGID GALVANIZED STEEL.
5.) ELBOWS AND OFFSETS GREATER THAN 30 DEGREES SHALL BE RIGID GALVANIZED STEEL. PROVIDE STEEL TO PLASTIC ADAPTER FITTINGS.
6.) CONDUITS SHALL BE PLACED ON CARLON HIGH IMPACT SPACERS 6-1/2" ON CENTER, SPACED 10" APART DOWN THE TRENCH LINE.
7.) UNDERGROUND DUCTBANKS SHALL BE SET A MINIMUM DEPTH OF 30" BELOW GRADE.
8.) ALL UNDERGROUND DUCTS SHALL BE ENCLOSED BY REINFORCED CONCRETE AS INDICATED ON THE DRAWING.
9.) REINFORCING STEEL SHALL BE INTERFACED WITH THE MANHOLE WALLS AND THE BUILDING FOUNDATION WALLS TO MINIMIZE SHEARING.
10.) ALL UNDERGROUND DUCTBANKS SHALL BE FIELD COORDINATED WITH EXISTING UNDERGROUND UTILITIES.
11.) ALL ENCASED RIGID GALVANIZED STEEL CONDUIT SHALL BE COATED WITH TWO COATS OF AN ASPHALTIC COMPOSITION AND ALLOWED TO DRY PRIOR TO BEING ENCLOSED.
12.) THE FIRST TEN FEET OF THE DUCTBANK EITHER ENTERING OR LEAVING A MANHOLE SHALL BE COATED WITH TWO COATS OF AN ASPHALTIC COMPOSITION OF THE TOP AND SIDE WALLS AND ALLOWED TO DRY PRIOR TO BACKFILL.

TYPICAL MAINLINE DUCTBANK RUN BETWEEN MANHOLES AND MAINLINE RISER POLES. MIN. SIZE CONDUIT 5"
A. The following duct bank components shall be submitted to the client for approval:

1. PVC Conduit.
2. PVC Fittings.
3. PVC High Impact Spacers.
4. RGC, IMC & EMT.
5. RGC, IMC & EMT Fittings.
6. Conduit Sealing Fittings.
SECTION 02620 - SUBDRAINAGE

1.1 SUMMARY

A. Section Includes:
   1. Perforated-wall pipe and fittings.
   2. Geotextile filter fabrics.

1.2 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.

1.3 WATERPROOFING FELTS

A. Material: Comply with ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-saturated organic felt.

1.4 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.
   2. Styles: Flat and sock.

END OF SECTION 02620
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
STORM DRAINAGE

SECTION 02630 - STORM DRAINAGE

1.1 SUMMARY

A. UNH makes every effort to mitigate stormwater discharge to the utility system. Please visit the UNH and NH DES Stormwater sites for additional information.

B. Section Includes:
   1. Pipe and fittings.
   2. Channel drainage systems.
   3. Encasement for piping.
   5. Cleanouts.
   7. Expansion joints.
   8. Catch basins.

1.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

1.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Shielded Couplings:
   1. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

1.4 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

1.5 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250): AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.


B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.


1.6 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:


2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.


1.7 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14 (ASTM C 14M).

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1.8 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.


3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

1.9 EXPANSION JOINTS

A. Ductile-Iron Flexible Expansion Joints:

1. Manufacturers:
   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.

2. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig (1725-kPa) minimum working pressure and for offset and expansion indicated.

1.10 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

2. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty and Extra-Heavy Duty.

3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:
1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1.11 ENCASEMENT FOR PIPING
A. Standard: ASTM A 674 or AWWA C105.
B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) or high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.
C. Form: Sheet or tube.
D. Color: Black or natural.

1.12 MANHOLES
A. Standard Precast Concrete Manholes:
1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.
B. Manhole Frames and Covers:
1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

1.13 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
2. Benches: Concrete, sloped to drain into channel.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

1.14 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Polymer-Concrete, Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Manufacturers:

1. ABT, Inc.
2. ACO USA.
5. Poly-Cast.

C. Sloped-Invert, Polymer-Concrete Systems:
1. Grates:
   a. Manufacturer's designation "Heavy or Medium Duty," with slots or perforations that fit recesses in channels.
   b. Material: Fiberglass, Galvanized steel, Gray iron or Stainless steel.

2. Covers: Solid gray iron if indicated. Clearly engraved Storm Water.

3. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

D. Narrow-Width, Level-Invert, Polymer-Concrete Systems:

1. Grates:
   a. Slots or perforations that fit recesses in channels.
   b. Material: Fiberglass, Galvanized steel, Gray iron or Stainless steel.

2. Covers: Solid gray iron if indicated.

3. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

E. Drainage Specialties: Precast, polymer-concrete units.

1. Large Catch Basins:
   a. 24-by-12-inch (610-by-305-mm) polymer-concrete body, with outlets in quantities and sizes indicated.
   b. Gray-iron slotted grate.
   c. Frame: Include gray-iron or steel frame for grate.

2. Small Catch Basins:
   a. 19- to 24-inch by approximately 6-inch (483- to 610-mm by approximately 150-mm) polymer-concrete body, with outlets in quantities and sizes indicated.
   b. Gray-iron slotted grate.
   c. Frame: Include gray-iron or steel frame for grate.

3. Oil Interceptors:
   a. Polymer-concrete body with interior baffle and four steel support channels and two 1/4-inch- (6.4-mm-) thick, steel-plate covers.
   b. Steel-plate covers.

4. Sediment Interceptors:
   a. 27-inch- (686-mm-) square, polymer-concrete body, with outlets in quantities and sizes indicated.
   b. 24-inch- (610-mm-) square, gray-iron frame and slotted grate.

F. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

1.15 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
7. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).
8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

1.16 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.
B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty, according to utility standards.

1.17 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-3, screen opening 2 inches (51 mm).
2. Average Size: NSSGA No. R-4, screen opening 3 inches (76 mm).
3. Average Size: NSSGA No. R-5, screen opening 5 inches (127 mm).


D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

END OF SECTION 02630
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS

ASPHALT PAVING

SECTION 02741 - ASPHALT PAVING

1.1 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Porous Asphalt: Shall be considered on a case by case basis. Please visit for specifications:
6. Pavement markings and paint.
7. Bicycle lanes.
10. ADA Tactile Warning Strips.

B. General: All sitework performed in the preparation and installation of asphalt pavement including sidewalks, fire lanes, streets, and parking lots shall be in accordance with most current version of “The Asphalt Institute.” This standard shall be used for all subgrade preparation, surface type, composition of mix, compaction, pavement structure and drainage work. In all case existing Asphalt should be reclaimed ground and re-used wherever and whenever possible. Every effort shall be made to use porous parking surfaces as an alternative to standard asphalt for new parking areas.

1. The use of islands shall be limited to areas where it is necessary to control safe flow of vehicle traffic.
2. Locate islands so as not to hinder snow removal operations.
3. Islands shall not be placed in areas such as parking lots for the sole purpose of aesthetics.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the New Hampshire DOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of The Asphalt Institute and Department of Transportation of New Hampshire for asphalt paving work.
1.3 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials and 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

1.4 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

1.5 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22, PG 58-28, or PG 70-22.

B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

1.6 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form. Product should be Green approved.

1. Color: White, Yellow

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint. Product should be Green approved.

1. Color: White, Yellow
C. Pavement Line and Markings: For durability, maximum visibility and enhanced public safety, unless waived, the University uses NHDOT and Town of Durham reflectorized paint and thermoplastic pavement markings and lines. Ideally, dual centerlines and single fog line/lane mark lines are installed. On core campus low volume streets, single center line and fog line omission may be considered if approved by the Traffic Safety Committee. Resurfaced pavement suggests the preferred use of thermoplastic pavement markings. Ongoing maintenance or over-painting of existing paint or thermoplastic markings requires the use of reflectorized paints to DOT standard. If required, obliteration of existing markings shall be by grinding or abrasion and not overpainting with paint, asphalt or any other material. In general, all pavement lines excluding crosswalks and stop lines should be 4” in width, applied in one pass and in single width. Stop lines shall be 18” in width. Crosswalks shall be standard continental bar style. See Attachment E.

On thermoplastic pavement line and marking installations special care should be taken to ensure application on well cured pavement, above minimum ambient temperature application and conforming material mix. Thermoplastic pavement marking standards can be found in detail in 2006 NHDOT Standard Specifications Section 632 - construction requirements.

On reflectorized paint pavement markings or over markings, the street should be swept clean and install lines be continuous, straight and pre-marked. The University mandates the use of ASTM approved standard 100% acrylic type, low VOC, fast drying white or yellow suitable for bituminous or concrete surfaces. Reflective beads should be added for street applications. Pavement marking paint standards can be found in detail in 2006 NHDOT Standard Specifications Section 708 – traffic paint identification.

1. All roads shall be striped with a double yellow line in the center.
2. All roads with or without curbing shall be striped on each outside edge with a white line.
3. All parking lots shall be striped with white traffic paint.
4. All paint used for striping shall meet requirements of State of New Hampshire specifications. Paint shall comply with Green Standards for application.

D. Miscellaneous Pavement Markings

1. Bike lane symbols and text see Chapter 5, Division 2, Section 02741 Attachments B and C.
2. Given the low speed nature of our streets, the University does not typically install other lane designation, advance stop, yield or similar in-lane surface pavement markings on UNH maintained streets. In the few cases where such markings exist or are proposed and approved by the UNH Traffic Safety Committee, markings should comply with standard MUTCD dimensions and styles and be compatible with Town of Durham use standards.

E. Glass Beads: AASHTO M 247, Type 1.

F. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, 4-1/2 inches (115 mm) high by 9 inches (225 mm) wide by 72
inches (1800 mm) long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 10-inch (254-mm) minimum length.

G. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4 inches (100 mm) high by 6 inches (150 mm) wide by 72 inches (1800 mm) long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 10-inch (254-mm) minimum length.
2. Adhesive: As recommended by wheel-stop manufacturer for application to asphalt pavement.

1.7 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, “Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.”

B. Porous Asphalt mixes shall be considered for all new parking areas on a case by case basis. All new parking areas will need to demonstrate the need for why porous pavements are not feasible prior to selection of standard hot-mix asphalt. In general, porous asphalt projects can be cost effective for new parking areas and are not limited by soil type. Porous asphalt pavement type will be selected based on durability needs. For parking lot reconstruction, the use of porous pavements may be limited due to cost associated with base preparation. Attachment A includes specifications for porous asphalt. Please visit the UNH Stormwater Center website to check for updates on application and specification details.


1.8 UNIVERSITY GUIDELINES

A. Sidewalks: All sidewalks around and leading to a facility shall be a minimum of 6 feet wide and a minimum of 3 inches thick, applied in two (2) lifts. Pavers may be considered for sidewalks and installed only with University signed approval. ADA indicator pads shall be installed at all sloped transitions.

B. Fire Lanes and Driveways: Provide a minimum of 12 feet wide, 4 inches thick, applied in two (2) lifts.

C. Streets: Provide a minimum of 32’ curb to curb wide, thickness determined by proposed usage of road as indicated in “The Asphalt Institute’s” specifications. Streets shall include a marked bike lane.

D. Parking Lots: Provide in a square or rectangular pattern, with minimum 4 inch thick asphalt, applied in two (2) lifts.
E. Curbing: All curbing shall be granite with a 4" reveal where vehicle climbing occurs, all other reveals 6". Curbing shall be vertical or sloping with application approved by University of New Hampshire Plant Maintenance.

F. Gravel:

1. All gravel utilized in the preparation of sidewalks, fire lanes and driveways shall be minimum 6 inch of ¾-inch bank run crushed gravel.
2. All gravel utilized for parking lots and roads shall be minimum 12 inch of 1-1/2 inch bank run crushed gravel.

G. Islands:

1. Provide islands with vertical granite curbing no more than 5 inches high.
2. Interior of islands shall be paved or filled with crushed stone no smaller than 1-inch in size.
3. Islands located by roadways shall contain no plant material, such as grass or shrubs.
4. Islands located away from roads and parking lots, and used to direct foot traffic, or are used for aesthetic purposes, shall be landscaped with trees, shrubs, and mulch or stone BUT MAY NOT CONTAIN GRASS. Ornamental grass shall be considered.
5. Islands utilized to separate parking lots from roadways shall not contain guardrails, fences, or any other like material which would hinder snow removal.
6. Islands located in parking lots lots shall be considered for use as bioretention systems or bioswales by use of curb cuts or drop inlets.
7. Bioretention and bioswales shall pond a maximum of 6” of water, and will be designed to promote detention time and infiltration. Soils must be designed for infiltration and evaluated for need of amendments. Overflow bypass shall be provided and plumbed to adjacent drainage network if necessary.
8. All areas that receive rainfall must be designed to drain within a maximum of 72 hours for vector control.

H. Bicycle Lanes:

1. See Attachment B and C for Bicycle Lane Markings.

I. Bus Stop Pull-Outs:

1. See Attachment D for Bus Stop options.

J. Mobility Impaired: Comply with ADA Requirements for handicap access where applicable.

1.9 DISPOSAL

A. Except for materials indicated to be recycled, remove excavated materials from project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.
ATTACHMENT:
Attachment A: UNHSC Design Specifications for Porous Asphalt Pavement & Infiltration Beds
Attachment B: Standard Bicycle Lane Marking
Attachment C: Shared Bicycle Lane Marking
Attachment D: Bus Stop Options
Attachment E: Crosswalk Striping

END OF SECTION 02741
UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds

Rev. October 2009
# UNHSC DESIGN SPECIFICATIONS FOR POROUS ASPHALT PAVEMENT AND INFILTRATION BEDS

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Part</th>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
<td>5</td>
</tr>
<tr>
<td>1.1</td>
<td>Description</td>
<td>5</td>
</tr>
<tr>
<td>1.2</td>
<td>Submittals</td>
<td>5</td>
</tr>
<tr>
<td>1.3</td>
<td>QC/QA</td>
<td>6</td>
</tr>
<tr>
<td>1.4</td>
<td>Project Conditions</td>
<td>6</td>
</tr>
<tr>
<td>1.5</td>
<td>References</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Products</td>
<td>8</td>
</tr>
<tr>
<td>2.1</td>
<td>Materials</td>
<td>8</td>
</tr>
<tr>
<td>2.1.1</td>
<td>Porous Media Infiltration Beds</td>
<td>8</td>
</tr>
<tr>
<td>2.1.1.1</td>
<td>Choker Course</td>
<td>8</td>
</tr>
<tr>
<td>2.1.1.2</td>
<td>Filter course material</td>
<td>8</td>
</tr>
<tr>
<td>2.1.1.3</td>
<td>Filter blanket material</td>
<td>8</td>
</tr>
<tr>
<td>2.1.1.4</td>
<td>Reservoir Coarse</td>
<td>9</td>
</tr>
<tr>
<td>2.1.1.5</td>
<td>Optional Bottom Liner</td>
<td>9</td>
</tr>
<tr>
<td>2.1.1.6</td>
<td>Non-woven geotextile filter fabric</td>
<td>10</td>
</tr>
<tr>
<td>2.1.1.7</td>
<td>Alternative Applications and Residential Driveways</td>
<td>11</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Porous Asphalt Mix</td>
<td>12</td>
</tr>
<tr>
<td>2.1.2.1</td>
<td>Mix materials</td>
<td>12</td>
</tr>
<tr>
<td>2.1.2.2</td>
<td>Polymer Modified PGAB and Mix Designs</td>
<td>12</td>
</tr>
<tr>
<td>2.1.2.3</td>
<td>Anti-Stripping Mix Additives</td>
<td>14</td>
</tr>
<tr>
<td>2.1.2.4</td>
<td>Coarse Aggregate</td>
<td>15</td>
</tr>
<tr>
<td>2.1.2.5</td>
<td>Fine Aggregate</td>
<td>15</td>
</tr>
<tr>
<td>2.1.2.6</td>
<td>Porous Asphalt Mix Design Criteria</td>
<td>15</td>
</tr>
<tr>
<td>2.1.3</td>
<td>Porous Asphalt Mix Production</td>
<td>16</td>
</tr>
<tr>
<td>2.1.3.1</td>
<td>Mixing Plants</td>
<td>16</td>
</tr>
<tr>
<td>2.1.3.2</td>
<td>Preparation of Asphalt Binder</td>
<td>16</td>
</tr>
<tr>
<td>2.1.3.3</td>
<td>Preparation of Aggregates</td>
<td>17</td>
</tr>
<tr>
<td>2.1.3.4</td>
<td>Mineral filler</td>
<td>17</td>
</tr>
<tr>
<td>2.1.3.5</td>
<td>Mixing</td>
<td>17</td>
</tr>
<tr>
<td>2.1.3.6</td>
<td>QC/QA During Production</td>
<td>17</td>
</tr>
<tr>
<td>2.1.3.7</td>
<td>Plant Shutdown and Rejection of Mix</td>
<td>18</td>
</tr>
<tr>
<td>2.1.3.8</td>
<td>Striping Paint</td>
<td>19</td>
</tr>
<tr>
<td>2.3</td>
<td>Execution</td>
<td>19</td>
</tr>
<tr>
<td>2.3.1</td>
<td>Installation</td>
<td>19</td>
</tr>
<tr>
<td>2.3.1.1</td>
<td>Porous Media Beds</td>
<td>19</td>
</tr>
<tr>
<td>2.3.1.2</td>
<td>Grade Control</td>
<td>19</td>
</tr>
<tr>
<td>2.3.1.3</td>
<td>Subgrade Preparation</td>
<td>19</td>
</tr>
<tr>
<td>2.3.1.4</td>
<td>Porous Media Bed Installation</td>
<td>20</td>
</tr>
<tr>
<td>2.3.1.5</td>
<td>QC/QA requirements for Porous Media Bed Construction</td>
<td>21</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (CONTINUED)

B. Porous Asphalt Pavement Installation ................................................................. 21
   1. Mixing Plant .................................................................................................... 21
   2. Hauling Equipment ....................................................................................... 21
   3. Placing Equipment ......................................................................................... 22
   4. Rollers ............................................................................................................ 22
   5. Conditioning of Existing Surface ................................................................. 23
   6. Temperature Requirements ......................................................................... 23
   7. Spreading and Finishing ............................................................................... 23
   8. Compaction ................................................................................................... 24
   9. Joints ............................................................................................................ 25
  10. Surface Tolerances ....................................................................................... 26
  11. Repair of Damaged Pavement ....................................................................... 26
  12. Striping Paint ................................................................................................ 26

C. QC/QA for Paving Operations .......................................................................... 26

PART 4. REFERENCES ............................................................................................. 27

LIST OF TABLES

Table 1. Submittal requirements ................................................................................. 6
Table 2. Gradations and compaction of choker, filter, and reservoir course materials. .... 11
Table 3. Non-woven geotextile filter fabric properties. .............................................. 12
Table 4. Post-Blended SBR Binder QC Plan requirements ........................................ 14
Table 5: Porous Asphalt Mix Design Criteria .......................................................... 16
Table 6. QC/QA testing requirements during production ......................................... 18
Table 7. QC/QA testing tolerances during production ............................................. 18
Table 8. QC/QA requirements for porous media bed construction ......................... 21
Table 9. QC/QA requirements during paving ......................................................... 27

LIST OF FIGURES

Figure 1: Typical Cross-Section for Pervious Pavement System ................................. 10
UNHSC DESIGN SPECIFICATIONS FOR
POROUS ASPHALT PAVEMENT AND INFILTRATION BEDS

NOTICE
The specifications listed herein were developed by the UNHSC for UNHSC related projects and represent the author’s best professional judgment. No assurances are given for projects other than the intended application. These design specifications are not a substitute for licensed, qualified engineering oversight and should be reviewed, and adapted as necessary.

ACKNOWLEDGEMENTS
The original 2007 specifications were completed by collaboration between the University of New Hampshire, of Durham, New Hampshire, and Pike Industries Inc., of Belmont, New Hampshire. The principal UNH authors were Joshua F. Briggs, Robert M. Roseen, PE, PhD, and Thomas P. Ballestero, PE, PhD, PH, CGWP, PG. The principal author from Pike Industries was the Corporate Quality Control Manager, Jeff Pochily. Other contributions to the project were made by Grant Swenson, also of Pike Industries. The revised specifications (2009) were prepared by the UNHSC after a round table discussion with New Hampshire Asphalt Manufacturers (Rick Charbonneau, Mark Charbonneau, and Keith Dane of Continental Paving, Jeff Lewis of Brox Industries, and Mary Wescott, Dave Duncan, and Jeff Pochily of Pike Industries) and a round table discussion with design engineers. The 2009 specifications were also reviewed and revised by Antonio P. Ballestero, Jr., PE.

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PART 1 GENERAL

1.1 DESCRIPTION

A. This specification is intended to be used for porous asphalt pavement in parking lot applications. Stormwater management functions of porous asphalt installations include water quality treatment, peak flow reduction, storm volume reduction via groundwater recharge, and increased hydrograph time lag. This specification is intended for a cold climate application based upon the field experience at the UNHSC porous asphalt parking lot located in Durham, New Hampshire, however the specification can be adapted to projects elsewhere provided that selection of materials and system design reflects local conditions, constraints, and objectives.

B. The work of this Section includes subgrade preparation, installation of the underlying porous media beds, and porous asphalt mix (mix) design, production, and installation. Porous media beds refer to the material layers underlying the porous asphalt pavement. Porous asphalt pavement refers to the compacted mix of modified asphalt, aggregate, and additives.


D. Alternative specifications for mix, such as Open Graded Friction Courses (OGFC) from Federal Agencies or state Departments of Transportation (DOT), may be used if approved by the Engineer. The primary requirements for the specifications of the mix are performance grade (PG) asphalt binder, binder content, binder draindown, aggregate gradation, air void content, retained tensile strength (TSR).

1.2 SUBMITTALS

A. Submit a list of materials proposed for work under this Section including the name and address of the materials producers and the locations from which the materials are to be obtained.

B. Submit certificates, signed by the materials producers and the relevant subcontractors, stating that materials meet or exceed the specified requirements, for review and approval by the Engineer.

C. Submit samples of materials for review and approval by the Engineer. For mix materials, samples may be submitted only to the QA inspector with the Engineer’s approval.

D. Submittal requirements for samples and certificates are summarized in 1.3 QC/QA

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

B. Codes and Standards - All materials, methods of construction and workmanship shall conform to applicable requirements of AASHTO ASTM Standards, NHDOT Standard Specifications for
Road and Bridge Construction, latest revised (including supplements and updates), or other standards as specified.

C. QC/QA requirements for production of mix are discussed in the Materials section, and for construction of the porous media beds and paving in the Execution section.

E. Table 1 and discussed in further detail in the Materials section.

1.3 QC/QA

D. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

E. Codes and Standards - All materials, methods of construction and workmanship shall conform to applicable requirements of AASHTO ASTM Standards, NHDOT Standard Specifications for Road and Bridge Construction, latest revised (including supplements and updates), or other standards as specified.

F. QC/QA requirements for production of mix are discussed in the Materials section, and for construction of the porous media beds and paving in the Execution section.

Table 1. Submittal requirements.

<table>
<thead>
<tr>
<th>Material or Pavement Course*</th>
<th>Properties to be reported on Certificate**</th>
</tr>
</thead>
<tbody>
<tr>
<td>choker course, reservoir course</td>
<td>gradation, max. wash loss, min. durability index, max. abrasion loss, air voids (reservoir course)</td>
</tr>
<tr>
<td>filter course</td>
<td>gradation, permeability/ sat. hydraulic conductivity</td>
</tr>
<tr>
<td>filter blanket</td>
<td>gradation</td>
</tr>
<tr>
<td>geotextile filter fabric</td>
<td>manufacturer's certification, AOS/EOS, tensile strength</td>
</tr>
<tr>
<td>striping paint</td>
<td>certificate</td>
</tr>
<tr>
<td>binder</td>
<td>PGAB certification</td>
</tr>
<tr>
<td>coarse aggregate</td>
<td>gradation, wear, fracture faces (fractured and elongated)</td>
</tr>
<tr>
<td>fine aggregate</td>
<td>gradation,</td>
</tr>
<tr>
<td>silicone</td>
<td>manufacturer's certification</td>
</tr>
<tr>
<td>Fibers (optional)</td>
<td>manufacturer's certification</td>
</tr>
<tr>
<td>mineral filler (optional)</td>
<td>manufacturer's certification</td>
</tr>
<tr>
<td>fatty amines (optional anti-strip)</td>
<td>manufacturer's certification</td>
</tr>
<tr>
<td>hydrated lime (optional anti-strip)</td>
<td>manufacturer's certification</td>
</tr>
</tbody>
</table>

* Samples of each material shall be submitted to the Engineer (or QA inspector for mix). These samples must be in sufficient volume to perform the standardized tests for each material.
** At a minimum, more material properties may be required (refer to Materials Section).

1.4 PROJECT CONDITIONS

A. Site Assessment should be performed per the steps outlined in IS 131 (NAPA, 2003).
B. **Construction Phasing** should be performed as outlined in IS 131 (NAPA, 2003).

C. **Protection of Existing Improvements**
   1. Protect adjacent work from the unintended dispersal/splashing of pavement materials. Remove all stains from exposed surfaces of pavement, structures, and grounds. Remove all waste and spillage. If necessary, limit access to adjacent work/structures with appropriate signage and/or barriers.
   2. Proper erosion and sediment control practices shall be provided in accordance with existing regulations. Do not damage or disturb existing improvements or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work. This includes the regular, appropriate inspection and maintenance of the erosion and sediment control measures.
   3. Restore damaged areas, including existing pavement on or adjacent to the site that has been damaged as a result of construction work, to their original condition or repair as directed to the satisfaction of the Engineer at no additional cost.

D. **Safety and Traffic Control**
   1. Notify and cooperate with local authorities and other organizations having jurisdiction when construction work will interfere with existing roads and traffic.
   2. Provide temporary barriers, signs, warning lights, flaggers, and other protections as required to assure the safety of persons and vehicles around and within the construction area and to organize the smooth flow of traffic.

E. **Weather Limitations**
   1. Porous asphalt, Open graded friction course, or dense-mixed asphalt shall not be placed between November 15 and March 15, or when the ambient air temperature at the pavement site in the shade away from artificial heat is below 16 °C (60 °F) or when the actual ground temperature is below 10 °C (50 °F). Only the Engineer may adjust the air temperature requirement or extend the dates of the pavement season.
   2. The Contractor shall not pave on days when rain is forecast for the day, unless a change in the weather results in favorable conditions as determined by the Engineer.

### 1.5 REFERENCES


F. *Section 401- Plant Mix Pavements – General*, in *Standard Specifications for Road and Bridge Construction – State of New Hampshire Department of Transportation*, 2006.


PART 2 PRODUCTS

2.1 MATERIALS

A. Porous Media Infiltration Beds

Below the porous asphalt itself are located the porous media infiltration beds (Figure 1), from top to bottom: a 4” – 8” (10 - 20 cm) (minimum) thick layer of choker course of crushed stone (8” is preferable to alleviate compaction issues with the porous asphalt); an 8” to 12” (20 cm to 30 cm) minimum thickness layer of filter course of poorly graded sand (a.k.a. bankrun gravel or modified 304.1); 3” (8 cm) minimum thickness filter blanket that is an intermediate setting bed (pea gravel); and a reservoir course of crushed stone, thickness dependant on required storage and underlying native materials. Alternatively, the pea gravel layer could be thickened and used as the reservoir course depending upon subsoil suitability. This alternative simplifies subbase construction. For lower permeability native soils, perforated or slotted drain pipe is located in the stone reservoir course for drainage. This drain pipe can be daylighted to receiving waters or connected into other stormwater management infrastructure (wetland, storm sewer, etc.). The fine gradation of the filter course is for enhanced filtration and delayed infiltration. The high air void content of the uniformly graded crushed stone reservoir course: maximizes storage of infiltrated water thereby allowing more time for water to infiltrate between storms; and creates a capillary barrier that arrests vertical water movement and in doing so prevents winter freeze-thaw and heaving. The filter blanket is placed to prevent downward migration of filter course material into the reservoir course. The optional underdrain in the reservoir course is for hydraulic relief (typically raised off of the bottom of the reservoir stone layer for enhanced groundwater recharge). Nonwoven geotextile filter fabric (geotextile) is used only for stabilizing the sloping sides of the porous asphalt system excavation and not to be used on the bottom of the system unless needed for structural reasons.

1. **Choker Course**

   Material for the choker course and reservoir course shall meet the following:

   - Maximum Wash Loss of 0.5%
   - Minimum Durability Index of 35
   - Maximum Abrasion Loss of 10% for 100 revolutions, and maximum of 50% for 500 revolutions.

Material for the choker course and reservoir course shall have the AASHTO No. 57 and AASHTO No. 3 gradations, respectively, as specified in
Table 2. If the AASHTO No. 3 gradation cannot be met, AASHTO No. 5 is acceptable with approval of the Engineer. AASHTO no. 3 is also suitable for the choker course.

2. **Filter course material**
   Filter course material shall have a hydraulic conductivity (also referred to as coefficient of permeability) of 10 to 60 ft/day at 95% standard proctor compaction unless otherwise approved by the Engineer. Great care needs to be used to not over compact materials. Over-compaction results in loss of infiltration capacity. The filter course material is commonly referred to as a bankrun gravel (modified NHDOT 304.1). In order to select an appropriate gradation, coefficient of permeability may be estimated through an equation that relates gradation to permeability, such as described in *Correlations of Permeability and Grain Size* (Shepherd, 1989) or in *Section 8.7 Estimation of Saturated Hydraulic Conductivity* (Freeze and Cherry, 1979). The hydraulic conductivity should be determined by ASTM D2434 and reported to the Engineer.

3. **Filter blanket material**
   Filter blanket material between the filter course and the reservoir course shall be an intermediate size between the finer filter course above, and the coarser reservoir course below, for the purpose of preventing the migration of a fine setting bed into the coarser reservoir material. An acceptable gradation shall be calculated based on selected gradations of the filter course and reservoir course using criteria outlined in the *HEC 11* (Brown and Clyde, 1989). A pea-gravel with a median particle diameter of 3/8” (9.5 mm) is commonplace.

4. **Reservoir Coarse**
   Reservoir Coarse thickness is dependent upon the following criteria (that vary from site to site):
   
   a. A 4” (10 cm) minimum thickness of reservoir course acts as a capillary barrier for frost heave protection. The reservoir course is located at the interface between subbase and native materials.

   b. 4-in. (10 cm) minimum thickness if the underlying native materials are either well drained (Hydrologic Group A soils).

   c. 8-in. (30 cm) minimum thickness if subdrains are installed. Subdrains ensure that the subbase is well drained.

   d. Subdrains, if included, are elevated a minimum of 4” (10 cm) from the reservoir course bottom to provide storage and infiltration for the water quality volume. If the system is lined,

   e. Subbase thickness is determined from subbase materials having sufficient void space to store the design storm.

   **Example:** If the 25-year storm is 5.1” (13 cm) of rainfall depth, and the reservoir void space is 30%, then the minimum subbase thickness = 5.1”/0.3 = 17” (43.2 cm).
f. Pavement system and subbase thickness are $\geq 0.65 \times$ design frost depth for area.

**Example:** Durham, New Hampshire, 48” (122 cm) = $D_{\text{maximum frost}}$, therefore the *minimum* depth to the bottom of the subbase = 0.65(48”) = 32” (81 cm).

5. **Optional Bottom Liner**
   Bottom Liner is only recommended for aquifer protection or infiltration prevention. This liner is to be located at the interface between subbase and native materials and is dependent upon the following:

   a. As with any infiltration system, care must be taken when siting porous asphalt systems close to locations where hazardous materials are handled/trafficked, or where high contaminant loading may threaten groundwater, or where infiltration is undesirable (nearby foundations, slope stability, etc.). In such cases, the systems can be lined to prevent infiltration yet still preserving water quality, hydrograph lag, and peak flow reduction benefits.


   c. Suitable liners may include Hydrologic Group D soils, HDPE liners, or suitable equivalent. Refer to state or USEPA guidelines regarding selection of impermeable liners (USEPA, 2004).

   d. Filter fabrics or geotextile liners are not recommended for use on the bottom of the porous asphalt system (at the base of the stone reservoir subbase) if designing for infiltration. Filter fabric usage in stormwater filtration has been known to clog prematurely. Graded stone filter blankets are recommended instead.

   e. Geotextile filter fabrics may be used if designing on poor structural, and low conductivity soils. Fabric usage would be limited to the bottom and sides of the excavation. No fabric is to be used within the subbase, only on the perimeter.

**Figure 1: Typical Parking Area Cross-Section for Pervious Pavement System**
Porous paving: 4-6" (10 - 15 cm) of porous asphalt

Choker Course: 4"-8" (10 – 20 cm) minimum

Filter Course: 8" - 12" (20 - 30 cm) minimum thickness of subbase (aka. bank run gravel or modified 304.1)

Filter Blanket: intermediate setting bed: 3" (8 cm) thickness of 3/8" (1 cm) pea gravel

Reservoir Course: 4" (10 cm) minimum thickness of 3/8" (2 cm) crushed stone for frost protection, 4-6" (10-15 cm) diameter perforated subdrains with 2" cover

Optional-Liner for land uses where infiltration is undesirable (e.g., hazardous materials handling, sole-source aquifer protection)

Native materials
### Table 2. Gradations and compaction of choker, filter, and reservoir course materials.

<table>
<thead>
<tr>
<th>US Standard Sieve Size Inches/mm</th>
<th>Choker Course (AASHTO No. 57)</th>
<th>Filter Course (Modified NHDOT 304.1)</th>
<th>Reservoir Course (AASHTO No. 3)</th>
<th>Reservoir Course Alternative* (AASHTO No. 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/150</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2½/63</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2/50</td>
<td>-</td>
<td>90 – 100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1½/37.5</td>
<td>100</td>
<td>35 – 70</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>1/25</td>
<td>95 - 100</td>
<td>0 – 15</td>
<td>90 – 100</td>
<td>-</td>
</tr>
<tr>
<td>¾/19</td>
<td>-</td>
<td>-</td>
<td>20 - 55</td>
<td>-</td>
</tr>
<tr>
<td>½/12.5</td>
<td>25 - 60</td>
<td>0 - 5</td>
<td>0 - 10</td>
<td>-</td>
</tr>
<tr>
<td>3/8/9.5</td>
<td>-</td>
<td>-</td>
<td>0 - 5</td>
<td>-</td>
</tr>
<tr>
<td>#4/4.75</td>
<td>0 - 10</td>
<td>70-100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>#8/2.36</td>
<td>0 - 5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>#200/0.075</td>
<td>0 – 6**</td>
<td>0 - 6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% Compaction ASTM D698 / AASHTO T99</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

* Alternate gradations (e.g. AASHTO No. 5) may be accepted upon Engineer’s approval.
** Preferably less than 4% fines

6. **Non-woven geotextile filter fabric**
Filter fabric is *only recommended* for the sloping sides of the porous asphalt system excavation. It shall be Mirafi 160N, or approved equal and shall conform to the specifications in
Table 3. Mirafi ® 160N is a non-woven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. 160N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

7. **Alternative Applications and Residential Driveways.**
The recommendations above are based on a commercial parking application for both traffic and contaminant load. Alternative applications such as residential driveways and low use applications may justify the use of alternative subbase thicknesses for the porous media beds, filter blanket, and geotextiles. Residential driveway applications have been designed with a subbase limited to only an 8” compacted choker course. Variations should consider structural load requirements for material thickness, and contaminant load for filter course thickness. A reduced total system thickness (Section 2.1.3.f) will subject the pavement to greater freeze thaw susceptibility.
Table 3. Non-woven geotextile filter fabric properties.

<table>
<thead>
<tr>
<th>Mechanical Properties</th>
<th>Test Method</th>
<th>Unit</th>
<th>Minimum Average Roll Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MD*</td>
<td>CD**</td>
</tr>
<tr>
<td>Grab Tensile Strength</td>
<td>ASTM D 4632</td>
<td>kN (lbs)</td>
<td>0.71 (160)</td>
</tr>
<tr>
<td>Grab Tensile Elongation</td>
<td>ASTM D 4632</td>
<td>%</td>
<td>50</td>
</tr>
<tr>
<td>Trapezoid Shear Strength</td>
<td>ASTM D 4533</td>
<td>kN (lbs)</td>
<td>0.27 (60)</td>
</tr>
<tr>
<td>Mullen Burst Strength</td>
<td>ASTM D 3786</td>
<td>kPa (psi)</td>
<td>2100 (305)</td>
</tr>
<tr>
<td>Puncture Strength</td>
<td>ASTM D 4833</td>
<td>kN (lbs)</td>
<td>0.42 (95)</td>
</tr>
<tr>
<td>Apparent Opening Size (AOS)</td>
<td>ASTM D 4751</td>
<td>mm (US Sieve)</td>
<td>0.212 (70)</td>
</tr>
<tr>
<td>Permittivity</td>
<td>ASTM D 4491</td>
<td>sec⁻¹</td>
<td>1.4</td>
</tr>
<tr>
<td>Permeability</td>
<td>ASTM D 4491</td>
<td>cm/sec</td>
<td>0.22</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>ASTM D 4491</td>
<td>lpm/m² (gpm/ft²)</td>
<td>4,477 (110)</td>
</tr>
<tr>
<td>UV Resistance (at 500 hours)</td>
<td>ASTM D 4355</td>
<td>% strength retained</td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Test Method</th>
<th>Unit</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASTM D 5261</td>
<td>g/m² (oz/yd²)</td>
<td>217 (6.4)</td>
</tr>
<tr>
<td>Weight</td>
<td>ASTM D 5199</td>
<td>cm² (mils)</td>
<td>1.9 (75)</td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
<td>m² (yd²)</td>
<td>410 (500)</td>
</tr>
<tr>
<td>Roll dimension (width x length)</td>
<td></td>
<td>m (ft)</td>
<td>4.5 x 91 (15 x 300)</td>
</tr>
<tr>
<td>Roll area</td>
<td></td>
<td>kg (lb)</td>
<td>99 (217)</td>
</tr>
</tbody>
</table>

*MD - Machine Direction; **CD - Cross-machine Direction

B. Porous Asphalt Mix

1. Mix materials
   Mix materials consist of modified performance grade asphalt binder (PGAB), coarse and fine aggregates, and optional additives such as silicone, fibers, mineral fillers, fatty amines, and hydrated lime. Materials shall meet the requirements of the NAPA’s Design, Construction, and Maintenance of Open-Graded Friction Courses, Information Series 115 (2002), except where noted otherwise below or approved in writing by the Engineer.

2. Polymer Modified PGAB and Mix Designs.
   The asphalt binder shall be a polymer and/or fiber modified Performance Graded asphalt binder (PGAB) used in the production of Superpave Hot Mix Asphalt (HMA) mixtures. Ideally for maximum durability, the PGAB shall be two grades stiffer than that required for dense mix asphalt (DMA) parking lot installations, which is often achieved by adding a polymer and/or fiber. Mix designs will meet or exceed criteria listed in Table 5

   The PGAB polymer modifiers are to be either styrene butadiene rubber (SBR) or styrene butadiene styrene (SBS). SBS is typically reserved for large projects as terminal pre-blending is required. SBR is feasible for smaller projects as it can be blended at the plant or terminal blended. The quantity of rubber solids in the SBR shall typically be 1.5-3% by weight of the bitumen.
content of the mix.

The dosage of fiber additives shall be either 0.3 percent cellulose fibers or 0.4 percent mineral fibers by total mixture mass. Fibers are a simple addition either manually for a batch plant or automated for larger drum plants. The binder shall meet the requirements of AASHTO M320.

The PGAB may be pre-blended or post-blended. The pre-blended binder can be pre-blended at the source or at a terminal. For post-blended addition, the modifier can either be in-line blended or injected into the pugmill at the plant.

The following asphalt mix designs are recommended:

a. **PG 64-28 with 5 pounds of fibers per ton of asphalt mix.** This mix is recommended for smaller projects with lower traffic counts or loading potential. This mix is manageable at common batch plants.

b. **Pre-Blended PG 64-28 SBS with 5 pounds of fibers per ton of asphalt mix.** This mix is recommended for large projects > 1acre where high durability pavements are needed. The SBS will be supplied by an approved PGAB supplier holding a Quality Control Plan approved by the state DOT. A Bill of Lading (BOL) will be delivered with each transport of PG 64-28 SBS. A copy of the BOL will be furnished to the QA inspector at the Plant.

c. **Post-Blended PG 64-28 SBR with 5 pounds of fibers per ton of asphalt mix.** This mix is recommended for projects where high durability pavements are needed. The SBR will be supplied by a HMA plant approved to perform in-line blending or blending by injection into the pugmill. A Post-Blended SBR Binder Quality Control Plan (Table 4) will be submitted to the Engineer for approval at least 10 working days prior to production.

d. **Pre-Blended PG 76-22 modified with SBS and 5 pounds of fibers per ton of asphalt mix.** This mix is recommended for large sites anticipating high wheel load (H-20) and traffic counts for maximum durability. The SBS will be supplied by an approved PGAB supplier holding a Quality Control Plan approved by the state DOT. A Bill of Lading (BOL) will be delivered with each transport of PG 76-22 SBS. A copy of the BOL will be furnished to the QA inspector at the Plant.

e. **Post-Blended PG 76-22 modified with SBR and 5 pounds of fibers per ton of asphalt mix.** This mix is recommended for large sites anticipating high wheel load (H-20) and traffic counts for maximum durability. The SBR will be supplied by a HMA plant approved to perform in-line blending or blending by injection into the pugmill. A Post-Blended SBR Binder Quality Control Plan (Table 4) will be submitted to the Engineer for approval at least 10 working days prior to production.

f. **Quality control plans** may be altered at the discretion of the Engineer and based on feasible testing as suggested by the asphalt producer. Certain QC testing requirements during production may not be feasible for small projects in which limited asphalt is generated. Some testing methods cannot be completed during the time needed during small batch (less than approximately 50 tons of porous asphalt mix) production. The feasibility should be assessed with the Engineer and producer.
Table 4. Post-Blended SBR Binder QC Plan requirements.

<table>
<thead>
<tr>
<th>The QC Plan will contain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Company name and address</td>
</tr>
<tr>
<td>2. Plant location and address</td>
</tr>
<tr>
<td>3. Type of Facility</td>
</tr>
<tr>
<td>4. Contact information for the Quality Control Plan Administrator</td>
</tr>
<tr>
<td>5. QC Tests to be performed on each PGAB</td>
</tr>
<tr>
<td>6. Name(s) of QC Testing Lab to perform QC and Process Control testing.</td>
</tr>
<tr>
<td>7. Actions to be taken for PG Binders and SBR in Non compliance</td>
</tr>
<tr>
<td>8. List of mechanical controls (requirements below)</td>
</tr>
<tr>
<td>9. List of process controls and documentation (requirements below)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of Mechanical Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Liquid SBR no-flow alert system with an “alert” located in the control room and automatic documentation of a no flow situation on the printout</td>
</tr>
<tr>
<td>2. Provide means of calibrating the liquid SBR metering system to a delivery tolerance of 1%.</td>
</tr>
<tr>
<td>3. A batching tolerance at the end of each day’s production must be within 0.5% of the amount of SBR solids specified.</td>
</tr>
<tr>
<td>4. Mag-flow meter (other metering system may be considered)</td>
</tr>
<tr>
<td>5. Method of sampling liquid SBR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of Process Controls and Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Printouts of liquid SBR and PG binder quantities must be synchronized within one minute of each other</td>
</tr>
<tr>
<td>2. SBR supplier certification showing the percent of SBR solids in liquid SBR</td>
</tr>
<tr>
<td>3. Test results of a lab sample blended with the specified dosage of SBR. At a minimum, provide the name of the PGAB and liquid SBR suppliers, and PGAB information such as grade and lot number, and SBR product name used for the sample.</td>
</tr>
<tr>
<td>4. MSDS sheet for liquid SBR</td>
</tr>
<tr>
<td>5. Handling, storage, and usage requirements will be followed as required by the liquid SBR manufacturer</td>
</tr>
<tr>
<td>6. At a minimum, provide a table showing proposed rate of SBR liquid (L/min.) in relation to HMA production rate (tons per hour, TPH) for the % solids in liquid SBR, quantity of SBR specified for HMA production, and the specific gravity of the SBR.</td>
</tr>
<tr>
<td>7. QCT or QC Plan Administrator must be responsible for documenting quantities, ensuring actual use is within tolerance, etc. All printouts, calculations, supplier certifications etc. must be filed and retained as part of the QCTs daily diary/reports.</td>
</tr>
<tr>
<td>8. Method and Frequency of testing at the HMA plant, including initial testing and specification testing.</td>
</tr>
</tbody>
</table>

*This Plan shall be submitted to the Engineer 10 days before production.

3. **Anti-Stripping Mix Additives.**
The mix shall be tested for moisture susceptibility and asphalt stripping from the aggregate by AASHTO T283. If the retained tensile strength (TSR) < 80% upon testing, a heat stable
additive shall be furnished to improve the anti-stripping properties of the asphalt binder. Test with one freeze-thaw cycle (rather than five recommended in NAPA IS 115). The amount and type of additive (e.g. fatty amines or hydrated lime) to be used shall be based on the manufacturer’s recommendations, the mix design test results, and shall be approved by the Engineer.
Silicone shall be added to the binder at the rate of 1.5 mL/m3 (1 oz. per 5000 gal). Fibers may be added per manufacturer and NAPA IS 115 recommendation if the draindown requirement cannot be met (<0.3% via ASTM D6390) provided that the air void content requirement is met (>18%, or >16% as tested with CoreLok device). Additives should be added per the relevant DOT specification and NAPA IS 115.

4. **Coarse Aggregate.**
Coarse aggregate shall be that part of the aggregate retained on the No. 8 sieve; it shall consist of clean, tough, durable fragments of crushed stone, or crushed gravel of uniform quality throughout. Coarse aggregate shall be crushed stone or crushed gravel and shall have a percentage of wear as determined by AASHTO T96 of not more than 40 percent. In the mixture, at least 75 percent, by mass (weight), of the material coarser than the 4.75 mm (No. 4) sieve shall have at least two fractured faces, and 90 percent shall have one or more fractured faces (ASTM D5821). Coarse aggregate shall be free from clay balls, organic matter, deleterious substances, and a not more than 8.0% of flat or elongated pieces (>3:1) as specified in ASTM D4791.

5. **Fine Aggregate.**
The fine aggregate shall be that part of the aggregate mixture passing the No. 8 sieve and shall consist of sand, screenings, or combination thereof with uniform quality throughout. Fine aggregate shall consist of durable particles, free from injurious foreign matter. Screenings shall be of the same or similar materials as specified for coarse aggregate. The plasticity index of that part of the fine aggregate passing the No. 40 sieve shall be not more than 6 when tested in accordance with AASHTO T90. Fine aggregate from the total mixture shall meet plasticity requirements.

6. **Porous Asphalt Mix Design Criteria.**
The Contractor shall submit a mix design at least 10 working days prior to the beginning of production. The Contractor shall make available samples of coarse aggregate, fine aggregate, mineral filler, fibers and a sample of the PGAB that will be used in the design of the mixture. A certificate of analysis (COA) of the PGAB will be submitted with the mix design. The COA will be certified by a laboratory meeting the requirements of AASHTO R18. The Laboratory will be certified by the state DOT, regional equivalent (e.g. NETTCP), and/or qualified under ASTM D3666. Technicians will be certified by the regional certification agency (e.g. NETTCP) in the discipline of HMA Plant Technician. Bulk specific gravity (SG) used in air void content calculations shall not be determined and results will not be accepted using AASHTO T166 (saturated surface dry), since it is not intended for open graded specimens (>10% AV). Bulk SG shall be calculated using AASHTO T275 (paraffin wax) or ASTM D6752 (automatic vacuum sealing, e.g. CoreLok). Air void content shall be calculated from the bulk SG and maximum theoretical SG (AASHTO T209) using ASTM D3203.
The materials shall be combined and graded to meet the composition limits by mass (weight) as shown in Table 5.

Table 5: Porous Asphalt Mix Design Criteria.

<table>
<thead>
<tr>
<th>Sieve Size (inch/mm)</th>
<th>Percent Passing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75/19</td>
<td>100</td>
</tr>
<tr>
<td>0.50/12.5</td>
<td>85-100</td>
</tr>
<tr>
<td>0.375/9.5</td>
<td>55-75</td>
</tr>
<tr>
<td>No.4/4.75</td>
<td>10-25</td>
</tr>
<tr>
<td>No.8/2.36</td>
<td>5-10</td>
</tr>
<tr>
<td>No.200/0.075 (#200)</td>
<td>2-4</td>
</tr>
</tbody>
</table>

| Binder Content (AASHTO T164) | 6 - 6.5% |
| Fiber Content by Total Mixture Mass | 0.3% cellulose or 0.4% mineral |
| Rubber Solids (SBR) Content by Weight of the Bitumen | 1.5-3% or TBD |
| Air Void Content (ASTM D6752/AASHTO T275) | 16.0-22.0% |
| Draindown (ASTM D6390)* | < 0.3 % |
| Retained Tensile Strength (AASHTO 283)** | ≥ 80 % |
| Cantabro abrasion test on unaged samples (ASTM D7064-04) | ≤ 20% |
| Cantabro abrasion test on 7 day aged samples | ≤ 30% |

*Cellulose or mineral fibers may be used to reduce draindown.
**If the TSR (retained tensile strength) values fall below 80% when tested per NAPA IS 131 (with a single freeze thaw cycle rather than 5), then in Step 4, the contractor shall employ an antistrip additive, such as hydrated lime (ASTM C977) or a fatty amine, to raise the TSR value above 80%.

C. Porous Asphalt Mix Production

1. **Mixing Plants.**
   Mixing plants shall meet the requirements of hot mix asphalt plants as specified in the state DOT or regional equivalent unless otherwise approved by the Engineer (e.g. Section 401-Plant Mix Pavements – General for Quality Assurance specifications in the Standard Specifications for Road and Bridge Construction – State of New Hampshire DOT, 2006, or latest revised edition and including supplemental specifications and updates).

2. **Preparation of Asphalt Binder.**
The asphalt material shall be heated to the temperature specified in the state DOT specification (if using a DOT spec for the mix) in a manner that will avoid local overheating. A continuous supply of asphalt material shall be furnished to the mixer at a uniform temperature.
3. **Preparation of Aggregates.**
The aggregate for the mixture shall be dried and heated at the mixing plant before being placed in the mixer. Flames used for drying and heating shall be properly adjusted to avoid damaging the aggregate and depositing soot or unburned fuel on the aggregate.

4. **Mineral filler**
Mineral filler if required to meet the grading requirements, shall be added in a manner approved by the Engineer after the aggregates have passed through the dryer.

5. **Mixing.**
The above preparation of aggregates does not apply for drum-mix plants. The dried aggregate shall be combined in the mixer in the amount of each fraction of aggregate required to meet the job-mix formula and thoroughly mixed prior to adding the asphalt material.

The dried aggregates shall be combined with the asphalt material in such a manner as to produce a mixture that when discharged from the pugmill is at a target temperature in the range that corresponds to an asphalt binder viscosity of 700 to 900 centistokes and within a tolerance of ± 11 °C (± 20 °F).

The asphalt material shall be measured or gauged and introduced into the mixer in the quantity determined by the Engineer for the particular material being used and at the temperature specified in the relevant specification.

After the required quantity of aggregate and asphalt material has been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt material throughout the aggregate is secured. The mixing time will be regulated by the Engineer.

All plants shall have a positive means of eliminating oversized and foreign material from being incorporated into the mixer.

6. **QC/QA During Production**
The Contractor shall provide at Contractors’ expense and the Engineer’s approval a third-party QA Inspector to oversee and document mix production. All mix testing results during production should be submitted to the QA Inspector.

The QC plan may be altered at the discretion of the Engineer and based on feasible testing as suggested by the asphalt producer. Certain QC testing requirements during production may not be feasible for small projects in which limited asphalt is generated. Some testing methods cannot be completed during the time needed during small batch production. The feasibility should be assessed with the Engineer and producer.

The mixing plant shall employ a Quality Control Technician (QCT). The QCT will perform QC/QA testing and will be certified in the discipline of HMA Plant Technician by the relevant certifying agency (e.g. NETTCP in New England). The Contractor shall sample, test and evaluate the mix in accordance with the methods and minimum frequencies in Table 6 and the
Post-Blended SBR Binder Quality Control Plan (if applicable).

**Table 6. QC/QA testing requirements during production.**

<table>
<thead>
<tr>
<th>Test</th>
<th>Min. Frequency</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature in Truck at Plant</td>
<td>6 times per day</td>
<td></td>
</tr>
<tr>
<td>Gradation</td>
<td>greater of either (a) 1 per 500 tons, (b) 2 per day, or (c) 3 per job</td>
<td>AASHTO T30</td>
</tr>
<tr>
<td>Binder Content</td>
<td>greater of either (a) 1 per 500 tons, (b) 2 per day, or (c) 3 per job</td>
<td>AASHTO T164</td>
</tr>
<tr>
<td>Air Void Content</td>
<td>greater of either (a) 1 per 500 tons, (b) 2 per day, or (c) 3 per job</td>
<td>ASTM D6752</td>
</tr>
<tr>
<td>Binder Draindown</td>
<td>greater of either (a) 1 per 500 tons, (b) 1 per day, or (c) 1 per job</td>
<td>ASTM D6390</td>
</tr>
</tbody>
</table>

If an analyzed sample is outside the testing tolerances immediate corrective action will be taken. After the corrective action has been taken the resulting mix will be sampled and tested. If the re-sampled mix test values are outside the tolerances the Engineer will be immediately informed. The Engineer may determine that it is in the best interest of project that production is ceased. The Contractor will be responsible for all mix produced for the project.

Testing Tolerances During Production. Testing of the air void content, binder draindown, and TSR shall be within the limits set in Table 6. The paving mixture produced should not vary from the design criteria for aggregate gradation and binder content by more than the tolerances in Table 7.

**Table 7. QC/QA testing tolerances during production.**

<table>
<thead>
<tr>
<th>Sieve Size (inch/mm)</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75/19</td>
<td>-</td>
</tr>
<tr>
<td>0.50/12.5</td>
<td>±6.0</td>
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</tr>
<tr>
<td>No.4/4.75</td>
<td>±5.0</td>
</tr>
<tr>
<td>No.8/2.36</td>
<td>±4.0</td>
</tr>
<tr>
<td>No.200/0.075 (#200)</td>
<td>±2.0</td>
</tr>
<tr>
<td>%PGAB</td>
<td>+0.4, -0.2</td>
</tr>
</tbody>
</table>

Should the paving mixture produced vary from the designated grading and asphalt content by more than the above tolerances, the appropriate production modifications are to be made until the porous asphalt mix is within these tolerances.

Samples of the mixture, when tested in accordance with AASHTO T164 and T30, shall not vary from the grading proportions of the aggregate and binder content designated by the Engineer by more than the respective tolerances specified above and shall be within the limits specified for the design gradation.

7. **Plant Shutdown and Rejection of Mix.**

Should the porous asphalt mix not meet the tolerances specified in this section upon repeat testing, the Engineer may reject further loads of mix. Mix that is loaded into trucks during the...
time that the plant is changing operations to comply with a failed test shall not be accepted, and should be recycled at the plant.

8. **Striping Paint**
Striping paint shall be latex, water-base emulsion, ready-mixed, and complying with pavement marking specifications PS TT-P-1952.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. **Porous Media Beds**
Protection of native materials from over compaction is important. Proper compaction of select subbase materials is essential. Improper compaction of subbase materials will result in either 1) low pavement durability from insufficient compaction, or 2) poor infiltration due to over-compaction of subbase. Care must be taken to assure proper compaction as detailed below.

1. **Grade Control**
   
   a. Establish and maintain required lines and elevations. The Engineer shall be notified for review and approval of final stake lines for the work before construction work is to begin. Finished surfaces shall be true to grade and even, free of roller marks and free of puddle-forming low spots. All areas must drain freely. Excavation elevations should be within +/- 0.1 ft ( +/- 3 cm).
   
   b. If, in the opinion of the Engineer, based upon reports of the testing service and inspection, the quality of the work is below the standards which have been specified, additional work and testing will be required until satisfactory results are obtained.
   
   c. The Engineer shall be notified at least 24 hours prior to all porous media bed and porous pavement work.

2. **Subgrade Preparation**
   
   a. Native subgrade refers to materials beyond the limit of the excavation. The existing native subgrade material under all bed areas shall NOT be compacted or subject to excessive construction equipment traffic prior to geotextile and stone bed placement. Compaction is acceptable if an impermeable liner is used at the base of the porous asphalt system and infiltration is not desired.
   
   b. Where erosion of the native material subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed with light equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rake or equivalent and light tractor.

   c. Bring subgrade to line, grade, and elevations indicated. Fill and lightly regrade any areas
damaged by erosion, ponding, or traffic compaction before the placing of the stone subbase.

d. All bed bottoms are as level as feasible to promote uniform infiltration. For pavements subbases constructed on grade, soil or fabric barriers should be constructed along equal elevation for every 6-12” of grade change to act as internal check dams. This will prevent erosion within the subbase on slope.

3. Porous Media Bed Installation

a. Subbase refers to materials below pavement surface and above native subgrade. Upon completion of subgrade work, the Engineer shall be notified and shall inspect at his/her discretion before proceeding with the porous media bed installation.

b. Sideslope geotextile and porous media bed aggregate shall be placed immediately after approval of subgrade preparation. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of geotextile at no extra cost to the Owner.

c. Place sideslope geotextile in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of sixteen inches (16”). Secure geotextile at least four feet (1.2 m) outside of the bed excavation and take any steps necessary to prevent any runoff or sediment from entering the storage bed.

d. Install filter course aggregate in 8-inch maximum lifts to a MAXIMUM of 95% standard proctor compaction (ASTM D698 / AASHTO T99). Install aggregate to grades indicated on the drawings.

e. Install choker, gravel, and stone base course aggregate to a MAXIMUM of 95% compaction standard proctor (ASTM D698 / AASHTO T99). Choker should be placed evenly over surface of filter course bed, sufficient to allow placement of pavement, and notify Engineer for approval. Choker base course thickness shall be sufficient to allow for even placement of the porous asphalt but no less than 4-inches (10 cm) in depth.

f. The density of subbase courses shall be determined by AASHTO T 191 (Sand-Cone Method), AASHTO T 204 (Drive Cylinder Method), or AASHTO T 238 (Nuclear Methods), or other approved methods at the discretion of the supervising engineer.

g. The infiltration rate of the compacted subbase shall be determined by ASTM D3385 or approved alternate at the discretion of the supervising engineer. The infiltration rate shall be no less 5-30 ft/day or 50% of the hydraulic conductivity (D2434) at 95% standard proctor compaction (refer to section 2.1.A.5).

h. Compaction of subbase course material shall be done with a method and adequate water to meet the requirements. Rolling and shaping shall continue until the required density is attained. Water shall be uniformly applied over the subbase course materials during compaction in the amount necessary for proper consolidation.
i. Rolling and shaping patterns shall begin on the lower side and progress to the higher side of the subbase course while lapping the roller passes parallel to the centerline. Rolling and shaping shall continue until each layer conforms to the required grade and cross-section and the surface is smooth and uniform.

j. Following placement of subbase aggregate, the sideslope geotextile shall be folded back along all bed edges to protect from sediment washout along bed edges. At least a four-foot edge strip shall be used to protect beds from adjacent bare soil. This edge strip shall remain in place until all bare soils contiguous to beds are stabilized and vegetated. In addition, take any other necessary steps to prevent sediment from washing into beds during site development. When the site is fully stabilized, temporary sediment control devices shall be removed.

4. QC/QA requirements for Porous Media Bed Construction. QC/QA activities are summarized in Table 8.

B. Porous Asphalt Pavement Installation

1. Mixing Plant
The mixing plant, hauling and placing equipment, and construction methods shall be in conformance with NAPA IS 131 and applicable sections of the state DOT’s specification for asphalt mixes. The use of surge bins shall not be permitted.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor to notify Engineer for approval</td>
<td>24 hours in advance of start of work</td>
</tr>
<tr>
<td>Contractor to employ soil inspector acceptable to</td>
<td></td>
</tr>
<tr>
<td>Engineer</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor to employ staking and layout control</td>
<td></td>
</tr>
<tr>
<td>inspector acceptable to Engineer</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor to employ site grading inspector</td>
<td></td>
</tr>
<tr>
<td>acceptable to Engineer</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor to employ pavement work inspector</td>
<td></td>
</tr>
<tr>
<td>acceptable to Engineer</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor to notify Engineer for approval</td>
<td>after subgrade preparation, before</td>
</tr>
<tr>
<td></td>
<td>construction of porous media bed</td>
</tr>
<tr>
<td>Contractor to notify Engineer for approval</td>
<td>after choker course placed, before</td>
</tr>
<tr>
<td></td>
<td>placement of pavement</td>
</tr>
</tbody>
</table>

2. Hauling Equipment.
The open graded mix shall be transported in clean vehicles with tight, smooth dump beds that have been sprayed with a non-petroleum release agent or soap solution to prevent the mixture from adhering to the dump bodies. Mineral filler, fine aggregate, slag dust, etc.
shall not be used to dust truck beds. The open graded mix shall be covered during transportation with a suitable material of such size sufficient to protect the mix from the weather and also minimize mix cooling and the prevention of lumps. When necessary, to ensure the delivery of material at the specified temperature, truck bodies shall be insulated, and covers shall be securely fastened. Long hauls, particularly those in excess of 25 miles (40 km), may result in separation of the mix and its rejection.

3. **Placing Equipment.**
   The paver shall be a self-propelled unit with an activated screed or strike-off assembly, capable of being heated if necessary, and capable of spreading and finishing the mixture without segregation for the widths and thicknesses required. In general, track pavers have proved superior for Porous Asphalt placement. The screed shall be adjustable to provide the desired cross-sectional shape. The finished surface shall be of uniform texture and evenness and shall not show any indication of tearing, shoving, or pulling of the mixture. The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.

   Pavers shall be equipped with the necessary attachments, designed to operate electronically, for controlling the grade of the finished surface.

   The adjustments and attachments of the paver will be checked and approved by the Engineer before placement of asphalt material.

   Pavers shall be equipped with a sloped plate to produce a tapered edge at longitudinal joints. The sloped plate shall be attached to the paver screed extension.

   The sloped plate shall produce a tapered edge having a face slope of 1:3 (vertical: horizontal). The plate shall be so constructed as to accommodate compacted mat thickness from 35 to 100 mm (1 1/4 to 4 inches). The bottom of the sloped plate shall be mounted 10 to 15 mm (3/8 to 1/2 inch) above the existing pavement. The plate shall be interchangeable on either side of the screed.

   Pavers shall also be equipped with a joint heater capable of heating the longitudinal edge of the previously placed mat to a surface temperature of 95 °C (200 °F), or higher if necessary, to achieve bonding of the newly placed mat with the previously placed mat. This shall be done without undue breaking or fracturing of aggregate at the interface. The surface temperature shall be measured immediately behind the joint heater. The joint heater shall be equipped with automated controls that shut off the burners when the pavement machine stops and reignite them with the forward movement of the paver. The joint heater shall heat the entire area of the previously placed wedge to the required temperature. Heating shall immediately precede placement of the asphalt material.

4. **Rollers.**
   Rollers shall be in good mechanical condition, operated by competent personnel, capable of reversing without backlash, and operated at speeds slow enough to avoid displacement of the asphalt mixture. The mass (weight) of the rollers shall be sufficient to compact the mixture to the required density without crushing of the aggregate. Rollers shall be
5. **Conditioning of Existing Surface.**
Contact surfaces such as curbing, gutters, and manholes shall be painted with a thin, uniform coat of Type RS-1 emulsified asphalt immediately before the asphalt mixture is placed against them.

6. **Temperature Requirements.**
The temperature of the asphalt mixture, at the time of discharge from the haul vehicle and at the paver, shall be between 135-163°C (275 to 325°F), within 6 °C (10 °F) of the compaction temperature for the approved mix design.

7. **Spreading and Finishing.**
The Porous Asphalt shall be placed either in a single application at 4 inches (10 cm) thick or in two lifts. If more than one lift is used, great care must be taken to insure that the porous asphalt layer join completely. This means: keeping the time between layer placements minimal; keeping the first layer clear from dust and moisture, and minimizing traffic on the first layer.

The Contractor shall protect all exposed surfaces that are not to be treated from damage during all phases of the pavement operation.

The asphalt mixture shall be spread and finished with the specified equipment. The mixture shall be struck off in a uniform layer to the full width required and of such depth that each course, when compacted, has the required thickness and conforms to the grade and elevation specified. Pavers shall be used to distribute the mixture over the entire width or over such partial width as practical. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture shall be spread and raked by hand tools.

No material shall be produced so late in the day as to prohibit the completion of spreading and compaction of the mixture during daylight hours, unless night paving has been approved for the project.

No traffic will be permitted on material placed until the material has been thoroughly compacted and has been permitted to cool to below 38 °C (100 °F). The use of water to cool the pavement is not permitted. The Engineer reserves the right to require that all work adjacent to the pavement, such as guardrail, cleanup, and turf establishment, is completed prior to placing the wearing course when this work could cause damage to the pavement. On projects where traffic is to be maintained, the Contractor shall schedule daily pavement.
operations so that at the end of each working day all travel lanes of the roadway on which work is being performed are paved to the same limits. Suitable aprons to transition approaches, where required, shall be placed at side road intersections and driveways as directed by the Engineer.

8. **Compaction.**
   Immediately after the asphalt mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The compaction objective is 16% - 19% in place void content (Corelock).

   Breakdown rolling shall occur when the mix temperature is between 135-163°C (275 to 325°F).

   Intermediate rolling shall occur when the mix temperature is between 93-135°C (200 to 275°F).

   Finish rolling shall occur when the mix temperature is between 66-93°C (150 to 200°F).

   The cessation temperature occurs at approximately 79°C (175°F), at which point the mix becomes resistant to compaction. If compaction has not been done at temperatures greater than the cessation temperature, the pavement will not achieve adequate durability.

   The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.

   Rollers or oscillating vibratory rollers, ranging from 8-12 tons, shall be used for compaction. The number, mass (weight), and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Generally, one breakdown roller will be needed for each paver used in the spreading operation.

   To prevent adhesion of the mixture to the rolls, rolls shall be kept moist with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

   Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot or lightly oiled hand tampers, smoothing irons or with mechanical tampers. On depressed areas, either a trench roller or cleated compression strips may be used under the roller to transmit compression to the depressed area.

   Other combinations of rollers and/or methods of compacting may be used if approved in writing by the Engineer, provided the compaction requirements are met.

   Unless otherwise specified, the longitudinal joints shall be rolled first. Next, the Contractor shall begin rolling at the low side of the pavement and shall proceed towards the center or high side with lapped rollings parallel to the centerline. The speed of the roller shall be slow and uniform to avoid displacement of the mixture, and the roller should
be kept in as continuous operation as practical. Rolling shall continue until all roller marks and ridges have been eliminated.

Rollers will not be stopped or parked on the freshly placed mat.

It shall be the responsibility of the Contractor to conduct whatever process control the Contractor deems necessary. Acceptance testing will be conducted by the Engineer using cores provided by the Contractor.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture. The mixture shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of binder shall be removed and replaced. These replacements shall be at the Contractor’s expense.

If the Engineer determines that unsatisfactory compaction or surface distortion is being obtained or damage to highway components and/or adjacent property is occurring using vibratory compaction equipment, the Contractor shall immediately cease using this equipment and proceed with the work in accordance with the fifth paragraph of this subsection.

The Contractor assumes full responsibility for the cost of repairing all damages that may occur to roadway or parking lot components and adjacent property if vibratory compaction equipment is used. After final rolling, no vehicular traffic of any kind shall be permitted on the surface until cooling and hardening has taken place, and in no case within the first 48 hours. For small batch jobs, curing can be considered to have occurred after the surface temperature is less than 100 °F (38 °C). Curing time is preferably one week, or until the entire surface temperature cools below 100 °F (38 °C). Provide barriers as necessary at no extra cost to the Owner to prevent vehicular use; remove at the discretion of the Engineer.


Joints between old and new pavements or between successive day’s work shall be made to ensure a thorough and continuous bond between the old and new mixtures. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed from the mat and a joint constructed.

Butt joints shall be formed by cutting the pavement in a vertical plane at right angles to the centerline, at locations approved by the Engineer. The Engineer will determine locations by using a straightedge at least 4.9 m (16 feet) long. The butt joint shall be thoroughly coated with Type RS-1 emulsified asphalt just prior to depositing the pavement mixture when pavement resumes.

Tapered joints shall be formed by tapering the last 450 to 600 mm (18 to 24 inches) of the course being laid to match the lower surface. Care shall be taken in raking out and discarding the coarser aggregate at the low end of the taper, and in rolling the taper. The taper area shall be thoroughly coated with Type RS-1 emulsified asphalt just prior to resuming pavement. As the paver places new mixture on the taper area, an evenly
graduated deposit of mixture shall complement the previously made taper. Shovels may be used to add additional mixture if necessary. The joint shall be smoothed with a rake, coarse material discarded, and properly rolled.

Longitudinal joints that have become cold shall be coated with Type RS-1 emulsified asphalt before the adjacent mat is placed. If directed by the Engineer, joints shall be cut back to a clean vertical edge prior to applying the emulsion.

10. **Surface Tolerances.**
The surface will be tested by the Engineer using a straightedge at least 4.9 m (16 feet) in length at selected locations parallel with the centerline. Any variations exceeding 3 mm (1/8 inch) between any two contact points shall be satisfactorily eliminated. A straightedge at least 3 m (10 feet) in length may be used on a vertical curve. The straightedges shall be provided by the Contractor.

Work shall be done expertly throughout, without staining or injury to other work. Transition to adjacent impervious asphalt pavement shall be merged neatly with flush, clean line. Finished pavement shall be even, without pockets, and graded to elevations shown on drawing.

Porous pavement beds shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on paved porous surfaces.

11. **Repair of Damaged Pavement.**
Any existing pavement on or adjacent to the site that has been damaged as a result of construction work shall be repaired to the satisfaction of the Engineer without additional cost to the Owner.

12. **Striping Paint**
Vacuum and clean surface to eliminate loose material and dust.

Paint 4 inch wide parking striping and traffic lane striping in accordance with layouts of plan. Apply paint with mechanical equipment to produce uniform straight edges. Apply in two coats at manufacturer's recommended rates. Provide clear, sharp lines using white traffic paint

**Color for Handicapped Markings: Blue**

C. **QC/QA for Paving Operations**

1. The full permeability of the pavement surface shall be tested by application of clean water at the rate of at least 5 gpm (23 lpm) over the surface, using a hose or other distribution devise. Water used for the test shall be clean, free of suspended solids and deleterious liquids and will
be provided at no extra cost to the Owner. All applied water shall infiltrate directly without large puddle formation or surface runoff, and shall be observed by the Engineer.

2. Testing and Inspection: Employ at Contractor's expense an inspection firm acceptable to the Engineer to perform soil inspection services, staking and layout control, and testing and inspection of site grading and pavement work. Inspection and list of tests shall be reviewed and approved in writing by the Engineer prior to starting construction. All test reports must be signed by a licensed Engineer.

3. Test in-place base and surface course for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable work as directed by the Engineer.

4. Surface Smoothness: Test finished surface for smoothness using a 10 foot straightedge applied parallel with and at right angles to the centerline of the paved area. Surface will not be accepted if gaps or ridges exceed 3/16 of an inch.

5. QC/QA requirements during paving are summarized in Error! Reference source not found..

Table 9. QC/QA requirements during paving.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule/Frequency</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect truck beds for pooling (draindown)</td>
<td>every truck</td>
<td>NA</td>
</tr>
<tr>
<td>Take surface temp. behind joint heater</td>
<td>each pull</td>
<td>6°C (10°F) of compaction temp</td>
</tr>
<tr>
<td>Consult with Engineer to determine locations of butt joints</td>
<td>as needed</td>
<td>NA</td>
</tr>
<tr>
<td>Test surface smoothness &amp; positive drainage with a 10 ft straigtedge</td>
<td>after compaction</td>
<td>4.5 mm (3/16&quot;)</td>
</tr>
<tr>
<td>Consult with Engineer to mark core locations for QA testing</td>
<td>after compaction</td>
<td>NA</td>
</tr>
<tr>
<td>Hose test with at least 5 gpm water</td>
<td>after compaction</td>
<td>immediate infiltration, no puddling</td>
</tr>
</tbody>
</table>

PART 4. REFERENCES

CalTrans, January 2003, California Stormwater BMP Handbook 3 of 8 New Development and Redevelopment, California Dept. of Transportation, Sacramento, CA  
www.cabmphandbooks.com

USEPA, September, 1999, Storm Water Technology Fact Sheet: Infiltration Drainfields, Number: 832F99018  USEPA, Office of Water, Washington, DC  


Vermont Agency of Transportation, 2006, 2006 Standard Specifications for Construction Book, Division 700, Section 708, Montpelier, VT.

Wisconsin Department of Natural Resources, Feb. 2004, Site Evaluation for Stormwater Infiltration(1002), Wisconsin Department of Natural Resources Conservation Practice Standards Madison, WI
STANDARD BICYCLE LANE MARKING

NOTES:
1. REFER TO MUTCD, LATEST EDITION, FOR SIZE OF BIKE LANE SYMBOL AND DIRECTIONAL ARROW.
2. BIKE LANE SYMBOLS AND DIRECTIONAL ARROW SHALL BE CENTERED IN THE BIKE LANE.

BIKE LANE SYMBOL WITH DIRECTIONAL ARROW

NOT TO SCALE
SHARED BICYCLE LANE MARKING

All rounded corners
25 mm (1 in) radius

NO SCALE

152 mm x 152 mm grid
(6 in x 6 in)
CROSSWALK STRIPING

RETOREFLECTIVE THERMOPLASTIC PAINT MARKING 24" (632.3124)

2.0'  3.0'  8.0'

NOTE: FINAL LOCATION MAY BE ADJUSTED BY THE OWNER/ENGINEER TO SUIT FIELD CONDITIONS.
SECTION 02751 - CEMENT CONCRETE PAVEMENT

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.
6. ADA Tactile warning strips.
   a. Pavers: [Link]
   b. Porous concrete: Standards in Process

B. UNH may entertain the placement of porous concrete on a case by case basis. Please visit the following website for specifications for porous concrete: ACI 522.1-08: Specification for Pervious Concrete Pavement available at [Link]

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

1.4 STEEL REINFORCEMENT

A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

F. Deformed-Steel Wire: ASTM A 496/A 496M.

G. Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

1.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:


C. Water: Potable and complying with ASTM C 94/C 94M.


E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1.6 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

1.7 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

1.8 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

1.9 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes. Green Products only.

1. Color: White, Yellow

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White, Yellow

1.10 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, Solid, integrally colored, 96 percent recycled HDPE, or commingled postconsumer and postindustrial recycled rubber or plastic; UV stabilized.

1. Color: Black, Yellow, Gray, Green, or Blue.

2. Dowels: Galvanized steel, 3/4 inch (19 mm) in diameter, 10-inch (254-mm) minimum length.

3. Adhesive: As recommended by wheel stop manufacturer for application to concrete pavement.
1.11 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M).

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

C. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m).

D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

1.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
SECTION 02780 - UNIT PAVERS

1.1 SUMMARY

A. Section Includes:
   1. Concrete pavers set in aggregate, bituminous and mortar setting beds.
   2. Porous Paver: Shall be considered on a case by case basis. Standard still in progress.
   3. Steel or Aluminum edge restraints.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

1.3 CONCRETE PAVERS

A. Regional Materials: Provide concrete pavers that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.

   1. Thickness: 2-3/8 inches (60 mm).
   2. Face Size and Shape: 4-by-8-inch (102-by-203-mm) rectangle.
   3. Color: Blends of greys or grey/sand.
   4. Manufacturers:
      a. Genest Pavers; Sanford, ME.
      b. Ideal Pavers; Westford, MA, distributed through Goodrich (Epping, NH).
      c. Unilock Pavers; Uxbridge, MA, distributed through Land Care (Madbury, NH).

C. Steel Edge Restraints: Manufacturer's standard painted steel edging 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high OR 1/4 inch (6.4 mm) thick by 5 inches (125 mm) high with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c., and steel stakes 15 inches (380 mm) long for each loop.
1. Manufacturers:
   b. Collier Metal Specialties, Inc.
   c. J. D. Russell Company (The).
   d. Sure-loc Edging Corporation.
   e. Duraedge

2. Color: As selected by University from manufacturer's full range.

D. Aluminum Edge Restraints: Manufacturer's standard straight, 1/8-inch- (3.2-mm-) thick by 4-inch- (100-mm-) high OR straight, 3/16-inch- (4.8-mm-) thick by 4-inch- (100-mm-) high OR L-shaped, 1/8-inch- (3.2-mm-) thick by 1-3/8-inch- (35-mm-) high OR L-shaped, 3/16-inch- (4.8-mm-) thick by 2-1/4-inch- (57-mm-) high extruded-aluminum edging with loops pressed from face to receive stakes at 12 inches (300 mm) o.c., and aluminum stakes 12 inches (300 mm) long for each loop.

1. Manufacturers:
   a. Brickstop Corporation.
   b. Curv-Rite, Inc.
   c. Permaloc Corporation.
   d. Sure-loc Edging Corporation.

1.4 ACCESSORIES

A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.


1.5 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.

B. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

C. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

D. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
   2. Permittivity: 0.5 per second, minimum; ASTM D 4491.
E. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form. Green Products only.

1.6 BITUMINOUS SETTING-BED MATERIALS

A. Fine Aggregate for Setting Bed: ASTM D 1073, No. 2 or No. 3.
B. Asphalt Cement: ASTM D 3381, Viscosity Grade AC-10 or Grade AC-20.
C. Neoprene-Modified Asphalt Adhesive: Paving manufacturer’s standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.
D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

1.7 MORTAR SETTING-BED MATERIALS

A. Regional Materials: Provide aggregate, cement, and lime for mortar that has been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
B. Portland Cement: ASTM C 150, Type I or Type II.
C. Hydrated Lime: ASTM C 207, Type S.
D. Sand: ASTM C 144.
E. Latex Additive: Manufacturer’s standard acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
F. Water: Potable.

1.8 GROUT MATERIALS

A. Regional Materials: Provide aggregate and cement for grout that has been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
B. Polymer-Modified Tile Grout: ANSI A118.7, sanded.
   1. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
C. Grout Colors: As selected by University from manufacturer’s full range.
D. Water: Potable.

1.9 BITUMINOUS SETTING-BED MIX

A. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate unless otherwise indicated. Heat mixture to 300 deg F (149 deg C).

1.10 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers’ written instructions. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement and latex additive to a creamy consistency.


1.11 INSTALLATION

A. Joint Pattern: Basket weave or herringbone; with a border.

1. Pattern and selected paver shall withstand snowplowing operations and service vehicle traffic.

B. Provide unit pavers under all bicycle racks.

END OF SECTION 02780

ATTACHMENTS:

Attachment A: Crosswalk Detail ICPI-13
Attachment B: Sidewalk Detail ICPI-17
NOTES:
1. BASE THICKNESS VARIES WITH TRAFFIC, CLIMATE, AND SUBGRADE. COLDER CLIMATES AND WEAK SOIL MAY REQUIRE THICKER BASES.
2. BOTTOM ELEVATION OF EXISTING ASPHALT PAVEMENT MUST BE BELOW BEDDING SAND.
3. CONCRETE BEAMS AT ENDS OF PAVEMENT MAY BE NECESSARY IF ASPHALT IS SUBJECT TO RUTTING.
4. DO NOT PROVIDE DRAIN HOLES TO SUBGRADE WHEN WATER TABLE IS LESS THAN 2 FT. (0.6 M) FROM TOP OF SOIL SUBGRADE. PROVIDE DRAIN HOLES TO CATCH BASINS.
5. USE IN AREAS WITH CAR TRAFFIC ONLY.
GRAVEL: LOCATE AT LOWEST ELEVATIONS

BASE MATERIALS, SUBGRADE SOIL AND BASE COMPACTION.

(150 MM X 300 MM) CONCRETE CURB
SET 1/4" (7 MM) BELOW TOP OF PAVERS
AND CONTROL JOINTS @ 15'-0" (5 M) O.C.

CONCRETE PAVERS
2 3/8" (60 MM) MIN THICKNESS

1" (25 MM) BEDDING SAND

GEOTEXTILE OVER CONCRETE/ASPHALT
BASE - TURN UP AT SIDES.

CONCRETE/ASPHALT BASE
4" (100 MM) MIN. THICKNESS FOR CONCRETE
3" (75 MM) MIN. THICKNESS FOR ASPHALT

COMPACTED SOIL SUBGRADE
2" (50 MM) DIA. DRAIN HOLE. FILL WITH PEA
GRAVEL. LOCATE AT LOWEST ELEVATIONS

NOTES:
1. THICKNESS OF BASE WILL VARY WITH SUBGRADE CONDITIONS AND CLIMATE.
   COLDER CLIMATES MAY REQUIRE THICKER BASES.
2. CONSULT ICPI TECH SPEC 2 FOR GUIDELINES ON SPECIFICATIONS FOR
   BASE MATERIALS, SUBGRADE SOIL AND BASE COMPACTION.
SECTION 02781 - POROUS UNIT PAVING

1.1 SUMMARY

A. Section Includes:
   1. Porous paving consisting of concrete pavers set in aggregate setting beds.
   2. Edge restraints.
   3. Precast concrete curbs.
   4. Granite curbs.
   5. Refer to Chapter 5, Division 2, Section 02741 Attachment A for UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds.

1.2 ACTION SUBMITTALS

A. LEED Submittals:
   1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

1.3 CONCRETE UNIT PAVERS

A. Regional Materials: Pavers shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Solid Concrete Pavers for Porous Paving: Solid interlocking paving units of shapes that provide openings between units, complying with ASTM C 936, resistant to freezing and thawing when tested according to ASTM C 67, and made from normal-weight aggregates.
   1. Thickness: 2-3/8 inches (60 mm).
   2. Color: As selected by University from manufacturer's full range.

1.4 ACCESSORIES

A. Plastic Edge Restraints: Triangular PVC extrusions, 1-3/4 inches (45 mm) high by 3-1/2 inches (90 mm) wide OR 3-1/8 inches (80 mm) high by 9-1/2 inches (240 mm) wide, designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges, with pipe connectors and 3/8-inch- (9.5-mm-) diameter by 12-inch- (300-mm-) long steel spikes.
   1. Manufacturers:
a. BrickStop Corporation.
b. Cambridge Pavers, Inc.
c. Dimex Corporation.
d. Oly-Ola Edgings, Inc.
e. Pave Tech Inc.

B. Steel Edge Restraints: Painted steel edging, 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high OR 1/4 inch (6.4 mm) thick by 5 inches (125 mm) high, with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c., and with steel stakes 15 inches (380 mm) long for each loop.

1. Manufacturers:
   b. Collier Metal Specialties, Inc.
   c. Russell, J. D., Company (The).
   d. Sure-loc Edging Corporation.

2. Color: As selected by University from manufacturer's full range.

C. Aluminum Edge Restraints: Straight, 1/8 inch (3.2 mm) thick by 4 inches (100 mm) high OR Straight, 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high OR L-shaped, 1/8 inch (3.2 mm) thick by 1-3/8 inches (35 mm) high OR L-shaped, 3/16 inch (4.8 mm) thick by 2-1/4 inches (57 mm) high extruded-aluminum edging, with loops pressed from face to receive stakes at 12 inches (300 mm) o.c., and with aluminum stakes 12 inches (300 mm) long for each loop.

1. Manufacturers:
   a. BrickStop Corporation.
   b. Curv-Rite, Inc.
   c. Permaloc Corporation.
   d. Sure-loc Edging Corporation.

1.5 AGGREGATE SETTING-BED MATERIALS

A. Regional Materials: Aggregate and soil shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Graded Aggregate for Subbase: Sound crushed stone or gravel.

C. Graded Aggregate for Base Course: Sound crushed stone or gravel.

D. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

E. Soil Mix for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate blended with planting soil mix.
F. Graded Aggregate for Leveling Course: Sound crushed stone or gravel.

G. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured according to test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
3. Permittivity: 0.5 per second, minimum; ASTM D 4491.

1.6 CLEANING

A. All porous pavements requires cleaning (vacuuming) twice a year.

END OF SECTION 02781
SECTION 02870 - SITE FURNISHINGS

1.1 SUMMARY

A. Section includes the following, see Attachments A – J for details:
   1. Stone benches.
   2. Bicycle racks.
   3. Trash receptacles.
   4. No Smoking Signs:
   5. Ash receptacles.
   7. Materials and Fabrication of Site Railings and Other Custom Made Elements.

1.2 ACTION SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.3 STONE BENCHES

A. General: University has three styles of granite benches to be used as appropriate for a specific application and location. Refer to attached bench type details.

B. Regional Materials: Provide concrete pavers that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

   1. Material: Granite.
   2. Quarries:
      a. Chelmsford; Westford, MA.
      b. Swenson; Concord, NH.

1.4 NON STONE BENCHES AND TABLES

A. Materials: Units similar in size, material and appearance to those shown in Attachment E.

B. Suppliers: Barco, KirbyBuilt, Max-R or others of comparable durability and maintainability, as approved.
1.5 BICYCLE RACKS

A. General: Two types of bicycle racks are used on campus: Continuous loop ribbon rack that is fixed and free standing sled rack.

1. Overall Height: 36 inches (914 mm).
2. Installation of fixed ribbon rack: Ends of rack shall extend 1'-6" (457 mm) below grade, minimum.
   a. Racks shall be installed with sleeves and removable pins for removal during the winter months.

B. Manufacturers:

1. Custom Welding & Fabrication; West Nottingham, NH, or other manufacturers as approved by the University.

C. Bicycle Rack Construction: See Attachment F and G for construction of free standing sled racks.

1. Frame: Galvanized steel unpainted finish is standard, black paint is allowed only with University approval.
   a. Tubing OD: Not less than 1-3/4 inches (45 mm).
   b. Flat Bars: Not less than 3/8 inch by 3 inch (9.5 by 75 mm).

2. Installation Method for fixed ribbon rack:
   a. Galvanized steel sleeves, extending 2'-0" (600 mm) below grade and 3" (75 mm) shall be provided for end of rack. Sleeves shall be embedded in concrete.
   b. Sleeves and rack shall be factory-drilled prior to galvanizing to accept a 3' by 3/8" (914 by 9.5 mm) carriage bolt 1-1/2 inches (38 mm) above grade. Bike Racks shall be removable.

1.6 TRASH RECEPTACLES

A. General: Free-standing round trash receptacles.

B. Basis-of-Design Products: Subject to compliance with requirements, provide the following:

1. Exterior Trash Receptacle: 32 gallon Rubbermaid Weatherguard Black Container;
2. Recycling Containers: 20 gallon Rubbermaid Weatherguard Black Container;
   a. Funnel Top: Rubbermaid

C. Available Supplier: Central Paper; Manchester, NH.
D. Recycling Container Graphics: Surface-applied copy, content, and style as indicated on attached photo. Surface-applied content, layout and text font as indicated in Attachment H. Top of receptacle comes black from the manufacturer and must be locally painted blue to match Attachment H.

1. Copy: BOTTLES • CANS.

1.7 ASH RECEPTACLES

A. Materials: In the vicinity of residence halls only, provide free standing ash receptacles manufactured by “No Butts Bin,” 15” x 8” x 3” (H x W x D). Locations as described in Chapter 3, Section 2 titled “Site Design.” Units to be mounted on a grey recycled plastic post with the top cut at a slope, 48” high to the top of the unit. See Attachment I.

B. Finish: Stainless-Steel, Dull satin No. 6.

C. Graphics and Copy: Surface-applied clear vinyl sheet mounted to post directly below the receptacle. Refer to Attachment J.

1.8 STONE POSTS AND CHAINS

A. Material: Granite.

1. Thermal finish.
2. Provide radius corners.
3. Provide pedestal and top.
   a. Top: Hipped (sloped in four directions).

B. Size: 6 foot high by 8 inches by 8 inches (3 foot exposed).

C. Bolt: Bolt shall be threaded through the post and finish shall be darker to match chain on the bolt.

   1. Eyebolt: ½ inch diameter, 5 inches long (hot-dipped galvanized), sand blast.
   2. Chain: 7 inch - 8 inch sag, posts approximately 8’-10” apart.

     b. All chain sections shall have a consistent sag.

1.9 MATERIALS FOR SITE RAILINGS AND OTHER CUSTOM MADE ELEMENTS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

   1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
3. Structural Pipe and Tube: ASTM B 429/B 429M.
5. Castings: ASTM B 26/B 26M.

B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.

C. Stainless Steel: Free of surface blemishes and complying with the following:

1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
3. Tubing: ASTM A 554.

D. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.

1. Polyethylene: Fabricated from virgin plastic HDPE resin.
2. Recycled Content of Polyethylene: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

E. Anchors, Fasteners, Fittings, and Hardware: Manufacturer’s standard, corrosion-resistant-coated or non-corrodible materials; Stainless steel or Galvanized steel; commercial quality, tamperproof, vandal and theft resistant.

F. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:

1. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

1.10 FABRICATION OF SITE RAILINGS AND OTHER CUSTOM MADE ELEMENTS

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

1.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

1.12 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run directional finishes with long dimension of each piece.

END OF SECTION 02870

ATTACHMENTS:

Attachment A: BENCH TYPE 1
Attachment B: BENCH TYPE 2
Attachment C: BENCH TYPE 3
Attachment D: BENCH TYPE 4
Attachment E: NON STONE BENCHES AND TABLES
Attachment F: BICYCLE RACK (Tubing)
Attachment G: BICYCLE RACK (Steel Bars)
Attachment H: RECYCLE BIN
Attachment I: ASH RECEPTACLE
Attachment J: NO SMOKING SIGN TEXT
1. GRANITE TO BE CHELMSFORD, SWENSON OR APPROVED EQUAL

2. EASE ALL EXPOSED EDGES 3/8" RADIUS

3. PROVIDE SHOP DRAWINGS

4. OWNER TO INSTALL BENCHES LEVEL AND SET ALL BENCHES IN A GROUP AT THE SAME ELEVATION.
1. Granite to be Chelmsford, Swenson or approved equal
2. Ease all exposed edges 3/8” radius
3. Provide shop drawings
4. Owner to install benches level and set all benches in a group at the same elevation.

**Front Elevation**

*Scale: 1/2” = 1'-0”*

**Section**

*Scale: 3/4” = 1'-0”*

*JOY AHERNDT HERRIOTT '50*

*Cut thermal finish*

*SPLIT FINISH ALL SIDES*

*3/8”Ø x 6” stainless steel dowel, set in 1-3/8”Ø core drill, with non-shrink grout in legs*

*Finish grade*

*Finish material to be determined*

*Compacted backfill*

*4” gravel base*
1. Granite to be Chelmsford, Swenson or approved equal

2. Ease all exposed edges 3/8" radius

3. Provide shop drawings

4. Owner to install benches level and set all benches in a group at the same elevation.

---

**Front Elevation**

**Scale:** 1/2" = 1'-0"

---

**Section**

**Scale:** 3/4" = 1'-0"

---

**Bench Type 3**

02870 Attachment C-1
In Memory Of
Assistant Professor of Biochemistry and Molecular Biology

1. GRANITE TO BE CHELMSFORD, SWENSON OR APPROVED EQUAL
2. EASE ALL EXPOSED EDGES
   3/8” RADIUS
3. PROVIDE SHOP DRAWINGS
4. INSTALL BENCHES LEVEL
5. SET ALL BENCHES IN A GROUP AT THE SAME ELEVATION.

FRONT ELEVATION

SCALE: 3/4" = 1'-0"

SECTION

SCALE: 3/4" = 1'-0"
Recycled Plastic Bench Style – Barco, KirbyBuilt, and Max-R all make units similar to these shown.

Recycled Plastic Table and Bench examples

Concrete Table and Bench example
UNIVERSITY of NEW HAMPSHIRE
PLANNING, DESIGN AND CONSTRUCTION GUIDELINES

CONCRETE WALKWAY OR PAVING
1/2" X 6" STEEL PLATE, SEE SECTION
3/8" X 3" STEEL BAR

VARIES 14'-0" MIN.

PLAN
SCALE: 3/4" = 1'-0"

3/8" X 3" STEEL BAR
CONTINUOUS FILLET WELD ALL FOUR
FACES, GRIND SMOOTH
1/2" X 6" STEEL PLATE FULL BUTT WELD ALL SECTIONS
AS NECESSARY TO OBTAIN TOTAL LENGTH, GRIND WELDS
SMOOTH.
FINISHED GRADE

SECTION A-A
SCALE: 3/4" = 1'-0"

NOTE: ALL STEEL AND WELDS
TO BE SHOP GALVANIZED.
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
SITE FURNISHINGS – ATTACHMENT H

RECYCLE BIN
ASH RECEPTACLE

“No Butts Bin” unit mounted to recycled plastic post – front view

“No Butts Bin” unit mounted to recycled plastic post – side view
NO SMOKING SIGN TEXT

IF YOU SMOKE

YOU MUST BE AT LEAST 20 FEET AWAY FROM ANY BUILDING

4” x 6” clear vinyl sheet with text font and size as shown
SECTION 02920 - LAWNS AND GRASSES

1.1 SUMMARY

A. Section Includes:
   1. Seeding.
   2. Sodding.

B. General: The University of New Hampshire Grounds and Events Department discourages the use of sod unless conditions exist that prohibit seeding. Sod is not normally available with the diversity of turf cultivars that may be obtained by seeding. In areas where sod will abut existing lawns, a difference in color will be evident indefinitely. In general, seeded areas, when installed properly, will provide a stronger, more attractive lawn that is more resistant to pests and drought.

   1. Any turf areas in excess of 100 square feet shall be accessible with a 62-inch wide riding mower.

1.2 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
I. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 QUALITY ASSURANCE

A. Installer’s Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

   1. Pesticide Applicator: State licensed, commercial.

B. Landscape work shall be performed by firms specializing in landscaping and by qualified, experienced horticultural technicians.

C. Substitutions must be approved by UNH Grounds and Events Manager, or their appointee. Submit proof of non-availability.

D. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

   1. The soil-testing laboratory shall oversee soil sampling.
   2. Report suitability of tested soil for turf growth.

      a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
      b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

1.4 DELIVERY, STORAGE AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, if applicable.

B. Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.5 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion; unless otherwise directed by Landscape Architect or UNH Manager of Grounds and Events. Planting schedule for sod may be extended beyond the indicated time frames.

   1. Spring Planting: Between April 1 and June 1.
   2. Fall Planting: Between August 15 and September 15.
B. Excavation of future lawn areas that expose conditions detrimental to seed or sod establishment such as rubble, adverse drainage, or obstructions shall require notification of contract monitor or UNH Manager of Grounds and Events.

1.6 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Turf: 60 days from date of planting completion.
   a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: 30 days from date of planting completion.

3. Automatic temporary irrigation systems shall be a standard practice for all new installations.

1.7 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances. Provide seed bearing the present season's certification tag stating species and varieties present, germination percentage, and seed purity.

B. Seed Species: All seed shall consist of Triplex Kentucky Bluegrass and Triplex Perennial Ryegrass mixed at a ratio of 1:1 by volume. State-certified seed of grass species as follows:

1. Triplex Bluegrass Mix:
   a. 40% Baron Kentucky Bluegrass.
   b. 50% Merit Kentucky Bluegrass.
   c. 10% Georgetown Kentucky Bluegrass.

2. Triplex Ryegrass Mix:
   a. 40% Palmer Perennial Ryegrass.
   b. 40% Prelude Perennial Ryegrass.
   c. 20% Yorktown III Perennial Ryegrass.

C. Substitutions: Substitutions due to availability of seed mixtures shall be approved by the UNH Manager of Grounds and Events or their appointee. If seeding must be performed outside of normal planting period, modifications to the mixture may be
advisable, recommended changes and approval shall be obtained from UNH Grounds and Events Department.

1.8 TURFGRASS SOD

A. Turfgrass Sod: Approved, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, not less than two years old, free of weeds and undesirable native grasses, machine cut to thickness of ¾-inch excluding thatch, and capable of vigorous growth and development when planted. Sod shall be of uniform size and broken pads or pads that cannot support their own weight will be rejected.

B. Turfgrass Species: Provide sod composed of two or more of the following grass species:

1. Kentucky Bluegrass varieties.
2. Glade.
5. Ram 1.
6. Adelphi.

C. Substitutions shall be cleared through the UNH Manager of Grounds and Events.

1.9 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 85 percent calcium carbonate.

1. Granular lime formations that meet this requirement are acceptable.
2. Rates shall be determined by soil test results from Analytical Services Lab.

1.10 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch (19-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

1. Analysis and certification of compliance shall be submitted for approval before use.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
1.11 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 percent nitrogen, 2 percent phosphorous, and 1 percent potassium, by weight.
2. Apply at the rate of 3.5 lbs. per 1000 sq. ft.
3. Fertilizer shall contain at least 3 percent water insoluble nitrogen.

1.12 PLANTING SOILS

A. Topsoil that is brought in or reused from the Project site shall be tested at the UNH Analytical Services lab at contractor's expense. Provide a copy of test results and recommendations to the UNH Manager of Grounds and Events. No topsoil shall be used until test results have been approved and all required amendments for intended crop have been made.

B. Existing topsoil from on-site shall be stock-piled and may be reused as long as it meets the specifications for off-site topsoil.

1. Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process

C. Off-Site topsoil shall be friable, loam containing 10% - 25% organic matter after composting. The soil shall be free from toxic substances and particles of subsoil, roots, and rocks, over ½-inch in size. The soil shall be free from roots and vegetative parts of weeds and noxious weeds seeds. The pH of soil for use with ornamentals shall be adjusted to meet the requirements of the turfgrass to be used. A pH of 6.5 is required for turf.

1. Imported topsoil or manufactured topsoil from off-site sources; do not obtain from agricultural land, bogs or marshes.

D. Planting Soil: Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix soil with soil amendments and fertilizers to produce planting soil:

1.13 MULCHES

A. Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley; for seeding operations.
B. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials; for hydroseeding.

1.14 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction. Green Pesticides shall be used on all projects at UNH.

1.15 TURF AREA PREPARATION

A. Newly Graded Subgrades:

1. Provide adequate surface drainage throughout the area.
2. Provide a minimum grade of one-percent sloping away from the buildings.
3. Grades for turf areas shall not exceed 25% slope. If slopes greater than 25% cannot be avoided, retaining walls and/or ground covers shall be used.
4. Subsurface drain lines shall be constructed and connected to a functioning outlet if drainage is not adequate.
5. Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off University’s property.
6. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
7. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

   a. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Topsoil shall be provided at a minimum of 6 inches over all turf areas. Place ½ total amount of topsoil required. Work into the top of loosened subgrade to create a transition layer and place remainder of topsoil. Add soil amendments specified by UNH Analytical Services Lab and mix thoroughly into the topsoil. Half of the starter fertilizer shall be incorporated at this time. Soil pH shall be adjusted to bring it into the range of 6.4 to 6.6 within a period of three (3) months. The rest of the starter fertilizer shall be spread on top of finish grades.

C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

1. Finish grades shall be to the top of granite curb, walks, or other adjoining areas after light rolling and natural settlement. When applicable, allow for sod thickness. All areas shall be raked to remove all clods, rocks, weeds, roots, and
debris of any kind. Grading and shaping refinements shall be performed to bring surface to true uniform planes free from irregularities and to provide drainage and proper slopes to catch basins. Once areas have been finish raked, no heavy equipment or vehicles shall be allowed on them.

1.16 SEEDING

A. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed, with spreader or seeding machine, by sowing equal quantities in two directions at right angles to each other. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 4 lb/1000 sq. ft. (1.8 kg/92.9 sq. m).

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly to form a continuous blanket 1/2 to 1 inch in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. The soil surface of seeded areas shall be kept moist continuously until the seed has germinated, this usually takes three weeks when bluegrass is in the seed mix.
2. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

E. Protective fencing shall be erected and maintained to control traffic for 60 days and as required until lawn is established. Fence shall be removed when lawn is established and accepted.

1.17 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Grades for sod shall be flush with the top of walks and curbing after sod is installed and soil has settled. The finish grade of soil will normally be ¾ inch below walks before sod is in place.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
D. Saturate sod with fine water spray within 30 minutes of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

1.18 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and keep turf uniformly moist to a depth of 4 inches; until areas are accepted by the University.

1. The soil surface of seeded areas shall be kept moist continuously until the seed has germinated, this usually takes three weeks when bluegrass is in the seed mix.

2. Care shall be taken not to over water or it will be impossible to walk on these areas without damaging lawn.

3. Sod roots shall be kept moist until they are firmly rooted, this usually takes at least two weeks.

C. Maintain turf areas for 60 days after Substantial Completion, through two mowings and until acceptance by the UNH Grounds and Events Department. The UNH Manager of Grounds and Events shall be notified in writing as to the date that Grounds and Events is expected to begin maintenance of a completed project. If seeded in Fall and not given a full 60 days of maintenance, or if turf is not considered acceptable at end of growing season, continue maintenance the following Spring until an acceptable lawn is established. Any part of seeded areas which fail to show a uniform stand shall be reseeded every 21 days until areas are covered with grass.

1. Mow turf as soon as top growth is tall enough to cut, and at no time will turf exceed 3-1/2 inches in height. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Turf shall never be cut shorter than 2-1/2 inches, and in June, July, and August mowing at 3 inches shall be done to increase drought tolerance.

D. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed. Green Pesticides only for all new installations.

END OF SECTION 02920
SECTION 02930 - EXTERIOR PLANTS

1.1 SUMMARY

A. Section Includes:
   1. Plants.
   2. Planting soils.

1.2 LANDSCAPING, GENERAL

A. Every effort should be made to select plants native to the region and require minimal or no irrigation and do not require active maintenance or chemical input such as fertilizers.

B. This Section is intended to assist in the design and construction of campus exterior spaces. Compliance with this Section is not intended to take the place of the involvement of the UNH Grounds and Events Department in the early stages of the planning process. The University seeks to use indigenous plants or appropriate diversity to accomplish landscaping objectives.

C. Perform a site review before any design work is started for construction or renovation that will affect exterior spaces of the campus. Involve the UNH Manager of Grounds and Events in the review to determine the value of plant material in the area and what steps shall be taken to protect or move them.

D. Plans for exterior spaces shall be designed for low maintenance. Areas shall be planned so that maintenance is performed with power equipment vs. labor intensive hand work, especially for emergency response functions such as snow removal.

E. Plant selection and placement decisions shall be made in consideration with the mature size of the species and cultivar. Plantings which require repeated annual prunings, such as sheared hedges and shrubs that grow too large for the spaces they are placed, shall not be accepted. The correct selections make it possible to keep the shrubs at the desired size and shape through “natural” pruning techniques.

F. Diversity of plant species is necessary in order to reduce maintenance costs and ensure healthy plant growth. Monoculture has been proven to be devastating from an aesthetic, monetary and environmental perspective. In order to increase bio-diversity on campus it is required that no more than 5% of the plants selected for a Project are one species and no more than 10% be from one genus. Plant selections shall be site specific. Plants that are adaptable to a site will thrive, be healthier, more attractive and cost less to maintain over the years.

G. The most recent version of the following named standard shall be used: ANSI Z60.1,

1. American Standard for Nursery Stock
   1250 I Street, N.W., Suite 500
1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

G. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

H. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

J. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

K. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 PROJECT CONDITIONS

A. Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: Between April 1 and June 15.
2. Fall Planting: Between September 1 and October 15.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1, “American Standard for Nursery Stock.”

C. Substitutions shall be approved by UNH Manager of Grounds and Events or his appointee. Submit proof of non-availability.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

1. Provide tree wrap to protect tree trunks during shipping and handling.

B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

C. Handle planting stock by root ball.

D. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period for Trees and Shrubs: Three months from date of Substantial Completion.
1.8 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. All plants shall be healthy, freshly dug, and nursery grown under climatic conditions similar to that of the Project site and shall conform to the varieties and sizes specified.
2. Plants shall conform to the botanical names and standards of size, culture and quality for the highest grades and standards as complying with requirements of “American Standard for Nursery Stock,” ANSI Z60.1 – latest edition, and shall exceed these standards where specimens are called for.
3. Healthy, vigorous stock shall be provided, grown in recognized nursery in accordance with good horticultural practice and, free from weeds, disease, insects or their eggs, and defects such as abrasions or improper pruning cuts to limbs or roots.
4. Trees and shrubs shall be of good form and free from defects such as weak crotches and girdling roots. The trunk flare of all woody ornamentals shall be exposed prior to planting and the depth of the hole shall correspond to the height of the ball after any excess soil has been removed.

B. Deciduous Trees shall be provided balled and burlapped and shall not have been previously grown in containers. Trees shall be of height and caliper scheduled or shown with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem, single leader trees except where special forms are shown or listed.

C. Deciduous Shrubs shall be provided balled and burlapped and of height shown or listed and with not less than the minimum number of canes required by ANSI Z60.1 for type and height of shrub required. Balled and burlapped (B & B) stock previously grown in containers and showing circling roots will be rejected. Container grown stock may be accepted in lieu of B & B material provided no evidence of circling roots can be found.

D. Coniferous and broadleafed evergreens shall be balled and burlapped and at the sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well balanced form complying with requirements for other size relationships to the primary dimensions shown. B & B stock previously grown in containers and showing evidence of circling roots will be rejected. Container grown stock may be accepted in lieu of B & B material provided no evidence of circling roots can be found.
E. Ground Cover and Vines shall be provided established and well rotted in removable containers or integral peat pots with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.

F. Bulbs and Perennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

G. Label at least one plant of each variety with a securely attached waterproof tag with legible designation of botanical and common names. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread.

H. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

1.9 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

B. Topsoil that shall be brought in or reused from the site shall be tested at the UNH Analytical Services Lab at contractor’s expense. Provide a copy of test results and recommendations to the UNH Manager of Grounds and Events. No topsoil shall be used until test results have been approved and all required amendments for intended crop have been made.

C. Existing topsoil from on-site shall be stock-piled and may be reused as long as it meets the specifications for off-site topsoil.

D. Off-Site topsoil shall be friable, loam containing 10% - 25% organic matter after composting. The soil shall be free from toxic substances and particles of subsoil, roots, and rocks over ½-inch in size. The soil shall be free from roots and vegetative parts of weeds and noxious weeds seeds. The pH of soil for use with ornamentals shall be adjusted to meet the requirements of the different species to be planted.

1.10 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch (19-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

1. Analysis and certification of compliance shall be submitted for approval before use.
B. Organic biostimulant shall be a concentrated organic biostimulant that promotes root and shoot growth, increases stress resistance and reduces fertilizer requirements. Apply according to manufacturer’s written instructions.


1.11 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

1.12 MULCHES

A. Organic Mulch: Decomposed shredded bark from pine or spruce trees, from sawdust, wood chips or contaminants.

1.13 WEED-CONTROL BARRIERS

A. Landscape Fabric or Weed Control Fabric: NOT allowed.

1.14 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction. Pesticides should conform with Green Product labeling.

1.15 TREE STABILIZATION MATERIALS

A. Stakes and Guys:

1. Upright and Guy Stakes: Rough sawn, new cedar, free of knots, holes, cross grain, and other defects, 3” in diameter by 5 foot length, pointed at one end.
2. Tree-Tie Webbing: Broad bands of soft cloth, such as a webbing material, placed loosely around trunk of tree. Rope shall be used to tie webbing to the stakes by folding webbing and making a hole through double layer of material.
3. Guys shall be removed by the contractor at the close of the staking period set for the in the contract documents.
EXTERIOR PLANTS 02930 - 7

1.16 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer’s written instructions. Use only when absolutely necessary, such as when evergreens are fall planted.

B. Burlap: Non-synthetic, biodegradable.

C. Tree Wraps and Wound Dressings: Not allowed.

1.17 PREPARATION

A. Preparation for planting trees and shrubs in beds differs from planting individual specimens or rows of plants.

1. Amend soils when installing beds to meet requirements of the plants to be used as long as the entire root area is treated.

1.18 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 6 inches (150 mm); 12 inches (300 mm) for trees and shrubs. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off University’s property.

1. Apply fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
3. Spread planting soil to a depth of 12 inches (300 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

1.19 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter.
2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

B. Subsoil and topsoil removed from excavations may not be used as planting soil.

1.20 TREE AND SHRUB PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.

1. Look for the trunk flare (the point where the trunk widens and the roots begin). If the trunk flare is not visible, gently remove the soil from the top of the ball until the flare and the beginning of the horizontal lateral roots can be seen. Care shall be taken to avoid damaging roots. The flare is where the soil line should have been had the plant been grown and dug properly. The depth of the hole shall be the same as the distance from the bottom of the root ball to the trunk flare.
2. The soil shall be loosened far beyond the drip line of the plant and when digging the sides of the hole will slope up gradually away from the center. Any glazed areas in the soil created by the digging process shall be loosened or scored in order to allow roots and water to penetrate. Do not disturb the area below the plant or if it has already been disturbed ensure it is compacted to prevent settling of plant material. If the ball is wrapped only in burlap the top half of the burlap shall be removed after the plant has been placed in the hole. Any synthetic materials (plastic) used to cover root ball shall be removed entirely. Wire cages shall be cut while the tree is next to the hole, and the tree shall be rolled off the cage and into the hole. If the ball is loose or likely to fall apart, the bottom of the cage can be removed and the tree can be placed in the hole and the sides of the cage cut and removed.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Use planting soil for backfill.
2. Balled and Burlapped: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place
tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.

5. Continue backfilling process. Water again after placing and tamping final layer of soil. No nitrogen containing fertilizer shall be added at planting time. Once the plant is set and about one-third of the backfill is in place, saturate the soil with water. Fill the remainder of the hole to match existing or final grades but do not cover top of root ball. Apply organic biostimulant according to manufacturer’s written instructions and saturate the remainder of the backfill with water. Water out beyond the dripline.

D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grade.

1. Use planting soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant. The roots shall be cut vertically with a sharp knife or pruners at three evenly spaced places before planting.
3. Backfill around root ball layers, tamping to settle soil and eliminate voids and air pockets. When planting pit if approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil. No nitrogen containing fertilizer shall be added at planting time. Once the plant is set and about one-third of the backfill is in place, saturate the soil with water. Fill the remainder of the hole to match existing or final grades but do not cover top of root ball. Apply organic biostimulant according to manufacturer’s written instructions and saturate the remainder of the backfill with water. Water out beyond the dripline.

E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

1.21 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

1.22 TREE STABILIZATION

A. Install tree stabilization as follows:
1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125 – mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1830 mm) above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Use three stakes for trees less than 14 feet (4.2 m) high and more than 3 inches (75 mm) in caliper. Space stakes equally around trees.

3. Support trees with bands of cloth webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Webbing shall be tied off to stakes with rope threaded through holes in folded webbing.

B. Staking and Guying: Stake and guy trees more than 14 feet (4.2 m) in height and more than 3 inches (75 mm) in caliper. Securely attach no fewer than three guys to stakes 30 inches (760 mm) long, driven to grade.

1.23 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches (300 mm) and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 2-inch (50-mm) average thickness, with 48-inch (1200-mm) radius around trunks or stems. Do not place mulch within 3 inches (75 mm) of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2-inch (50-mm) average thickness of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

1.24 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

1. Watering shall be performed twice within the first 24 hours after plants have been installed and at least twice a week until the provisional acceptance by the UNH Grounds and Events Department. Watering shall be performed beyond the root ball in order to encourage root development past the planting hole. The UNH Manager of Grounds and Events shall be notified in writing as to the date the UNH Grounds and Events is expected to begin maintenance of the completed Project.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use practices to minimize the use of pesticides and reduce hazards.

D. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the work. Notify the University before each application is performed.

E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 02930
SECTION 02950 – STORMWATER MANAGEMENT

1.1 SUMMARY

A. The University makes every effort to mitigate stormwater discharge to the utility system. Low Impact Development (LID) site planning and design strategies must be used to the maximum extent practicable in order to reduce the generation of the water runoff volume for both new and redevelopment projects. Projects must document why LID strategies are not appropriate if not used to manage stormwater. Please visit the University and NH DES Stormwater sites for additional information.


B. Section Includes:

1. Definitions.
2. General Requirements.
4. Design Standards.

1.2 DEFINITIONS

A. Best Management Practices (BMP): Methods and means described in the most current edition of the New Hampshire Stormwater Manual (all volumes) for preventing or reducing pollution and detrimental impacts from stormwater runoff.

B. Buffer: A vegetated area separating a development from a sensitive resource or neighboring property in which proposed development is restricted or prohibited.

C. Development: Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations.

D. Disconnected Impervious Cover: The sum of the proposed areas of impervious cover and pavement that receive precipitation and, by means of implementing BMPs and LID strategies, is designed to capture and filtrate the precipitation from a 1-inch 24-hour rain event.

E. Disturbance: Any activity that significantly alters the characteristics of the terrain in such a manner as to impede or alter the hydrology or natural runoff pattern, or creates an unnatural runoff.

F. Effective Impervious Area (EIA): The total impervious cover area less the area of disconnected impervious cover.

G. Hydrologic Soil Group (HSG): A Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups
range from "A" soils, with high permeability and little runoff production, to "D" soils, which have low permeability rates and produce much more runoff.

H. Impervious Surface: A material with low permeability that impedes the natural infiltration of moisture into the ground so that the majority of the precipitation that falls on the surface runs off or is not absorbed into the ground. Common impervious surfaces include, but are not limited to, roofs, concrete or bituminous paving such as sidewalks, patios, driveways, roads, parking spaces or lots, storage areas, compacted gravel including drives and parking areas, oiled or compacted earthen materials, stone, concrete or composite pavers, wood, and swimming pools.

I. Low Impact Development (LID): Site planning and design strategies intended to maintain or replicate predevelopment hydrology through the use of source control and relatively small-scale measures integrated throughout the site to disconnect impervious surfaces and enhance filtration, treatment, and management of stormwater runoff as close to its source as possible. Examples of LID strategies are pervious pavement, rain gardens, green roofs, bioretention basins and swales, filtration trenches, and other functionally similar BMPs located near the runoff source.

J. Maximum Extent Practicable (MEP): To show that a proposed development has met a standard to the maximum extent practicable, the project must demonstrate the following: (1) all reasonable efforts have been made to meet the standard, (2) a complete evaluation of all reasonable management measures has been performed, and (3) if full compliance cannot be achieved, the highest practicable level of management is being implemented.

K. Native plants: Plants that are indigenous to the region, adapted to the local soil and rainfall conditions, and require minimal supplemental watering, fertilizer, and pesticide application.

L. Pavement: Areas of a site that are covered with pervious and/or impervious asphalt and concrete.

M. Porous Media: Material with open connected pore spaces that allows water to percolate through it such as granular soils, crushed stone, pervious pavements, and woven and non-woven geosynthetics.

N. Redevelopment: Any man-made change to previously improved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, and drilling operations.

O. Riparian: Referring to anything connected or immediately adjacent to the shoreline or bank of a stream, river, pond, lake, bay, estuary or other similar body of water.

P. Runoff: Stormwater that does not infiltrate into the ground and flows toward a below-ground or surface discharge location.

Q. Site: A lot, tract or parcel of land that includes but is not limited to the proposed area of disturbance and development activities.

R. Stormwater: Water that originates from precipitation events and accumulates on land.
S. Stormwater Management Plan: A written plan describing the proposed methods and measures to be implemented to prevent or minimize impacts to water quality and quantity from stormwater associated with a development or redevelopment project both during and after construction. It shall identify selected BMPs, LID strategies, and treatment practices to address those potential impacts, and contains the engineering design plans, specifications, and calculations of the management and treatment practices, and maintenance requirements for proper performance of the proposed practices.

T. Water Quality Treatment: the capture of sediment, nutrients, metals and hydrocarbons suspended in stormwater runoff from impervious surfaces before being conveyed to a storm sewer network or to another water quality treatment system. In most cases where no other local water body impairments exist, adequate treatment refers to documenting the treatment systems ability to remove 80% of the total suspended solids (TSS) on an annual basis. Where water quality impairments do exist adequate treatment refers to a system’s ability to meet maximum load allocations or not further impair the receiving water.

U. Water Quality Volume (WQv): The storage volume needed to capture and treat the runoff from the 1-inch 24-hour rainstorm for a specific contributing area. WQv shall be calculated using the following equation: \[ WQv = (P)(Rv)(A), \] where: \( P = 1 \) inch, \( Rv = \) the unitless runoff coefficient, \( Rv = 0.05 + 0.9(I) \), where \( I = \) the percent impervious cover draining to the discharge point, in decimal form, and \( A = \) total site area draining to the discharge point.

1.3 GENERAL REQUIREMENTS

A. All developments shall provide adequate management of stormwater runoff and prevent the discharge of stormwater runoff from creating or contributing to a water quality impairment. Developments that disturb 10,000 or more square feet must submit for review and approval, a Stormwater Management Plan (Plan) describing all proposed stormwater management system elements, practices, and associated designs, including all calculations and analyses of said designs. The University reserves the right to require any development that disturbs less than 10,000 square feet to submit and then implement an approved Stormwater Management Plan (complete as described below or abbreviated) to prevent degradation of local water resources. All elements of the Plan must be designed/prepared by a New Hampshire Registered Professional Engineer in accordance with the Design Standards below. The Plan must contain the following parts and presented in the order listed below:

1.4 STORMWATER MANAGEMENT PLAN

A. An Existing Conditions Site Plan showing all pre-development surface water bodies and wetlands, drainage patterns, and watershed boundaries, buffer zones, topographic contours with minimum 2-foot intervals, scale bar, north arrow, title block with project name, designer’s stamp and wetland scientist’s stamp (if applicable), legend, locus plan, benchmarks, and appropriate notes with datum and other plan references, instructions, and detail descriptions. The Existing Conditions Site Plan shall be such that all important site and hydrologic features are easily recognized. Existing buildings,
structures, pavement, utilities, and soils information with coding as HSG-A, B, C, or D shall be included on the Existing Conditions Site Plan. High Intensity Soil Survey (HISS) mapping may be required.

B. A Proposed Conditions Site Plan showing all proposed post-development temporary and permanent stormwater management system elements and erosion and sediment control BMPs and all important hydrologic features. The Proposed Conditions Site Plan must be at the same scale as the Existing Conditions Site Plan with consistent title block, plan features, and descriptors including but not limited to the following:

1. Existing and proposed topographic contours (2-foot minimum contour interval; 1-foot contour intervals may be required for sites with limited relief and/or where proposed stormwater outfalls are located adjacent to buffer zones)
2. Proposed areas of disturbance with total area of disturbance clearly labeled in square feet
3. Existing and proposed buildings and structures
4. Stormwater discharge locations keyed to drainage analyses
5. Plan references and notes (including sequence of soil disturbance)
6. Proposed and existing public and private utilities
7. Proposed project components to become property of or the responsibility of the University shall be labeled as such
8. Existing and proposed impervious surfaces and pavements with areas used to calculate EIA clearly identified and the square footage of each type identified and labeled.

C. Drainage Analysis that includes calculations comparing Pre- and Post-Development stormwater runoff rates (cubic feet per minute) and volumes (cubic feet) based on a 1-inch rainstorm, and the 2-year, 10-year, and 25-year 24-hour frequency storms. Calculations shall include, but not be limited to, the sizing of all structures and BMPs including of sizing of emergency overflow structures based on assessment of the 100-year 24-hour frequency storm discharge rate. Phased applications apply as though the development of the entire parcel were proposed in one application at one time.

D. Drainage Analysis Results Summary tabulated for each proposed outfall or catchment outlet point including runoff rates and volumes for each storm event analyzed above.

E. An Erosion and Sediment Control Plan for all proposed construction activities in accordance with New Hampshire Stormwater Manual Volume 3 (December 2008 or later version).

F. Copies of any additional permits or plans required for compliance with Environmental Protection Agency (EPA) and/or New Hampshire Department of Environmental Services (NHDES).

G. A comprehensive Operation and Maintenance Plan for long-term maintenance of all proposed stormwater management elements and BMPs including the proposed schedule of inspections and anticipated maintenance.
1.5 DESIGN STANDARDS

A. The Stormwater Management Plans submitted shall meet the following minimum requirements:

1. Where applicable, the Plan must comply with the EPA Phase II Stormwater Rules and the University’s MS4 Stormwater Discharge Permit, as amended.
2. All proposed measures shall be in accordance with the NH Stormwater Management Manual volume (December 2008 or future revision) a copy of which is available from NHDES:
   a. [Link to NH Stormwater Management Manual]

3. Water Quality Protection: All aspects of the application shall be designed to protect the water quality of the University’s water bodies as follows:
   a. No person shall locate, store, discharge, or permit the discharge of any treated, untreated, or inadequately treated liquid, gaseous, or solid materials of such nature, quantity, noxiousness, toxicity, or temperature that may run off, seep, percolate, or wash into surface or groundwaters so as to contaminate, pollute, harm, impair or contribute to an impairment of such waters.
   b. All storage facilities for fuel, chemicals, chemical or industrial wastes, and biodegradable raw materials shall meet the standards of the New Hampshire Department of Environmental Protection (NHDES), Water Supply and Pollution Control.
   c. All projects under review by the University of such magnitude as to require a stormwater permit from EPA or NHDES shall comply with the standards of EPA and/or NHDES AOT program, with respect to the export of total suspended solids and other pollutants.

4. Stormwater Management For New Development: All proposed stormwater management and treatment systems shall meet the following performance standards:
   a. Existing surface waters, including lakes, ponds, rivers, perennial and intermittent streams (natural or channelized), and wetlands shall be protected by the minimum buffer setback distances specified by State law. Stormwater and erosion and sediment control BMPs shall be located outside the specified buffer zone. Alternatives to stream and wetland crossings that eliminate or minimize environmental impacts shall be considered whenever possible. When necessary, as determined by the University, stream and wetland crossings shall comply with state recommended design standards to minimize impacts to flow and enhance animal passage (see University of New Hampshire Stream Crossing Guidelines May 2009, as amended):
   1) [Link to University of New Hampshire Stream Crossing Guidelines]

[Links and references are included as per the document's content.]
b. LID site planning and design strategies shall be used to the MEP in order to reduce the generation of the stormwater runoff volume for both new and redevelopment projects. A project must document why LID strategies are not appropriate if not used to manage stormwater.

c. All stormwater treatment areas shall be planted with native plantings appropriate for the site conditions: grasses, shrubs and/or other native plants in sufficient numbers and density to prevent soil erosion and to promote proper treatment of the proposed runoff.

d. All areas that receive rainfall runoff must be designed to drain within a maximum of 72 hours for vector control.

e. Snow and salt storage areas shall be covered or located such that no direct untreated discharges to receiving waters are possible from the storage site. Runoff from snow and salt storage areas shall enter treatment areas as specified above before being discharged to receiving waters or allowed to infiltrate into the groundwater.

f. Runoff shall be directed into recessed vegetated and landscape areas designed for treatment and/or filtration to the MEP to minimize EIA and reduce the need for irrigation systems.

g. The Plan shall make provisions to retain stormwater on the site by using the natural flow patterns of the site. Effort shall be made to utilize natural filtration and/or infiltration BMPs (i.e., bioretention areas, bioswales, subsurface filtration/infiltration systems, etc).

h. Measures shall be taken to control the post-development peak rate runoff so that it does not exceed pre-development runoff for the 2-year, 10-year and 25-year, 24-hour storm events. Similar measure shall be taken to control the post-development runoff volume to filtrate the WQv according to the following ratios of Hydrologic Soil Group (HSG) type versus infiltration rate multiplier: HSG-A: 1.0; HSG-B: 0.75; HSG-C: 0.4; HSG-D: 0.15. For sites where infiltration is limited or not practicable, the project must demonstrate that the project will not create or contribute to a water quality impairment.

i. Measures shall be taken to control erosion within the project area. Sediment in runoff water shall be trapped and retained within the project area using BMPs. Wetland areas and surface waters shall be protected from sediment.
o. All temporary control measures shall be removed after final site stabilization. Trapped sediment and other disturbed soil areas resulting from the removal of temporary measures shall be permanently stabilized prior to removal of temporary control measures.

p. All areas that receive rainfall must be designed to drain within a maximum of 72 hours for vector control.

q. Pervious parking surfaces shall be used as an alternative to impervious asphalt or concrete for general and overflow parking areas to the MEP. Pervious pavement shall be appropriately sited and designed for traffic and vehicle loading conditions.

r. Whenever practical, native site vegetation shall be retained, protected, or supplemented. Any stripping of vegetation shall be done in a manner that minimizes soil erosion.

s. All subsurface filtration BMPs shall include perforated underdrains positioned a minimum of 8-inches above the bottom of the filter bed to prevent extended periods of saturated conditions.

5. Redevelopment Project Requirements: Because redevelopment may present a wide range of constraints and limitations, an evaluation of options may be proposed to work in conjunction with broader state watershed goals and University Sustainability Initiatives. Stormwater requirements for redevelopment vary based upon the surface area of the site that is covered by existing impervious surfaces. In order to determine the stormwater requirements for redevelopment projects, the percentage of the site covered by existing impervious areas must be calculated.

For sites meeting the definition of a redevelopment project and having less than 40% existing impervious surface coverage, the stormwater management requirements will be the same as other new development projects with the important distinction that the project can meet those requirements either on-site or at an approved off-site location within the same subwatershed provided the project satisfactorily demonstrates that impervious area reduction and LID strategies and BMPs have been implemented on-site to the MEP.

For redevelopment sites with more than 40% existing impervious surface coverage, stormwater shall be managed for water quality in accordance with one or more of the following techniques, listed in order of preference:

a. Implement measures onsite that result in an EIA of at least 30% of the existing impervious surfaces and pavement areas, and 50% of the additional proposed impervious surfaces and pavement areas through the application of porous media; or

b. Implement other LID techniques onsite to the MEP to provide treatment for at least 50% of the redevelopment area; or

c. Implement off-site BMPs to provide adequate water quality treatment for an area equal to or greater than 50% of redevelopment areas may be used to meet these requirements provided that the project satisfactorily demonstrates that impervious area reduction, LID strategies, and/or onsite BMPs have been implemented to the MEP. An approved off-site location must be identified, the specific management measures identified, and an implementation schedule developed in accordance with University
review. The project must also demonstrate that there is no downstream drainage or flooding impacts as a result of not providing on-site management for large storm events. To comply with University watershed objectives the mitigation site should be situated in the same subwatershed as the development and impact the same receiving water.

6. Impervious Surfaces can negatively impact surface and ground water quality in a number of ways. Impervious surfaces, such as paved parking lots decrease infiltration and recharge of groundwater, provide an express route for runoff to reach waterways, provide a surface upon which pollutants can accumulate, and prevent the natural processing of pollutants in soil, plants, and wetlands. Therefore, all projects shall minimize the area of impervious surfaces, and address the potential negative impact of impervious surfaces on surface and groundwater resources.

The recommended total overall impervious cover of a site shall not exceed 30%. For purposes of complying with this requirement, impervious cover draining to green roofs (with living vegetation), porous pavements, or other Low Impact Development filter treatment systems can be subtracted from the calculation of total impervious cover.

7. University Sustainability Initiatives including the University the Biodiversity Education Initiative and the Culture and Sustainability Initiative shall be considered with the development of stormwater management plans.

8. Plan Approval and Review: The University shall approve the Stormwater Management Plan if it complies with the requirements of these guidelines and other requirements as provided by law. The technical review shall be performed by a qualified professional.

END OF SECTION 02950
SECTION 03300 - CAST-IN-PLACE CONCRETE

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
   
a. Include statement indicating costs for each product having recycled content.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.4 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

1.5 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.
1.6 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, graded.


1.7 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

1.8 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI’s “Manual of Standard Practice.”

1.9 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

1.10 STEEL REINFORCEMENT

A. General: Comply with CRSI’s “Manual of Standard Practice” for placing reinforcement.

1.11 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

1.12 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
B. Cold-Weather Placement: Comply with ACI 306.1.

C. Hot-Weather Placement: Comply with ACI 301.

1.13 CONCRETE PROTECTING, FINISHING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Finishing: clean and rub all exposed surfaces of concrete walls, columns, ceiling and parapets to remove stains, foreign matter, burrs, fins and any other surface irregularities after removal of form ties and after any rework and patching work is completed. Exposed surfaces shall be left true to line and plane and free from form marks and other imperfections. Cosmetic coatings used to disguise underlying defects are unacceptable.

1.14 CLEANING

A. Wash down of concrete trucks and related equipment shall be off-site in a location such that the residue will not be a problem for future landscaping, excavation, underground drainage systems, etc. No wash down shall occur near or into new or existing sanitary or storm drainage lines.

1.15 CONSTRUCTION WASTE MANAGEMENT

A. No dumping of excess concrete shall be permitted on-site.

END OF SECTION 03300
SECTION 04720 - CAST STONE

1.1 SUMMARY

A. Section Includes:
   1. Cast stone trim.
   2. Cast stone steps.
   3. Cast stone bollards.
   5. Cast stone curbing.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.

1.4 CAST STONE UNITS

A. Regional Materials: Provide cast stone units that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.

C. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

D. Colors and Textures: As selected by the University from manufacturer's full range.
1.5 MORTAR

A. Comply with requirements in Chapter 5, Division 4, Section 04810 for mortar materials and mixes.

B. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

1.6 SETTING CAST STONE IN MORTAR

A. Install cast stone units to comply with requirements in Chapter 5, Division 4, Section 04810.

1.7 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

A. Set units accurately in locations indicated with edges and faces aligned.
   1. Install anchors, supports, fasteners, and other attachments to secure units in place.
   2. Shim and adjust anchors, supports, and accessories.

B. Fill anchor holes with sealant.
   1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.

C. Set cast stone supported on clip or continuous angles on resilient setting shims. Hold shims back from face of cast stone a distance at least equal to width of joint.

D. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored.

E. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Chapter 5, Division 7, Section 07920.

END OF SECTION 04720
SECTION 04810 - UNIT MASONRY ASSEMBLIES

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Concrete building brick.
3. Concrete facing brick.
4. Face brick.

B. General:

1. Face brick shall be standard size, water-struck or equal, red with a range of flash to match brick used in that part of campus.
2. No single-wythe masonry walls allowed.
3. All masonry accessories shall be stainless-steel.
4. University is open to “Expressive Brick Design.”
5. For all historic structures, mortar joint profiles and mortar colors will specifically be approved by the University Architect. Mortar shall be tested to ensure compatibility with existing.
6. Sample panels shall be prepared for all proposed exterior materials.
7. Bricks shall be obtained from Regional suppliers within a 500 mile radius of the University, preferably brick that is manufactured in northern New England.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 QUALITY ASSURANCE

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.4 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.5 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.6 CONCRETE MASONRY UNITS

A. Regional Materials: Provide CMUs that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

1. Provide bullnose units for outside corners on all interior walls, unless otherwise indicated.

C. CMUs: ASTM C 90.

D. Concrete Building Brick: ASTM C 55.

E. Decorative CMUs: ASTM C 90.

F. Concrete Facing Brick: ASTM C 1634.

1.7 CONCRETE AND MASONRY LINTELS

A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout.

1.8 BRICK

A. Regional Materials: Provide brick that has been manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
B. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Face Brick: Facing brick complying with ASTM C 216.

1. Grade: SW.
2. Type: FBX.
3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
5. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).

1.9 MORTAR AND GROUT MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

1.10 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Stainless steel.

1.11 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
5. Stainless-Steel Sheet: ASTM A 666, Type 304.
6. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
1. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, stainless-steel wire.

1.12 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Use one of the following unless otherwise indicated:
1. Copper-Laminated Flashing: 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).
4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch (1.0 mm) thick.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
1.13 MISCELLANEOUS MASONRY ACCESSORIES

A. Weep/Vent Products: Use one of the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

3. Vinyl Weep Hole/Vent: T-shaped units made from flexible PVC, consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by University.

B. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and Provide one of the following configurations:
   a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep.
   b. Strips, not less than 1-1/2 inches (38 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
   c. Sheets or strips full depth of cavity and installed to full height of cavity.

1.14 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
1.15 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

1.16 TOLERANCES

A. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).

2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).

3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

1.17 LAYING MASONRY WALLS

A. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

B. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

1.18 MORTAR BEDDING AND JOINTING

A. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

B. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

1.19 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
3. Repointing: mortar shall match existing in type and color.
4. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

1.20 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off University’s property.

END OF SECTION 04810
SECTION 04900 - CLAY MASONRY AND STONE RESTORATION AND CLEANING

1.1 SUMMARY

A. Section includes maintenance of unit masonry (consisting of brick clay masonry) and stone assemblies (consisting of stone) restoration and cleaning as follows:

1. Repairing unit masonry, including replacing units.
2. Repairing stone masonry, including replacing units.
3. Repointing joints.
4. Cleaning exposed unit masonry and stone surfaces.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows:

1. Existing Brick: Test each type of existing masonry unit indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by University. Take testing samples from these units.

2. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes, and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis as necessary to supplement microscopical methods. Carefully remove existing mortar from within five locations designated by testing service.

3. Replacement Brick: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

B. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing on stone units as follows:
1. **Existing Stone:** Test each type of existing stone indicated for replacement, according to ASTM C 170 for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C 99 for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C 97 for absorption and bulk specific gravity. Carefully remove five existing stones from locations designated by University. Take testing samples from these stones.

2. **Existing Mortar:** Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes, and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis as necessary to supplement microscopical methods. Carefully remove existing mortar from within five locations designated by testing service.

3. **Replacement Stone:** Test each proposed type of replacement stone, according to ASTM C 170 for compressive strength, ASTM C 99 for modulus of rupture, and ASTM C 97 for absorption and bulk specific gravity.

1.4 **QUALITY ASSURANCE**

A. **Mockups:** Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.

1. **Masonry and Stone Repair:** Prepare sample areas for each type of masonry and stone material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than 2 adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work.

2. **Repointing:** Rake out joints in 2 separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of repointing required and repoint one of the areas.

3. **Cleaning:** Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of masonry/stone and surface condition.

1.5 **MASONRY MATERIALS**

A. **Face Brick:** Provide face brick, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.

1. Provide units with physical properties, colors, color variation within units, surface texture, size, and shape to match existing brickwork.

   a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.
1.6 STONE MATERIALS

A. Stone: Provide natural building stone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone and with physical properties.

1. For existing stone that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

1.7 CLEANING MATERIALS

A. Water: Potable.

B. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

C. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

1.8 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

1.9 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

1.10 MASONRY UNIT PATCHING

A. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1/4 inch (6 mm) thick, but not less than recommended by patching compound manufacturer.
2. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
3. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
4. Keep each layer damp for 72 hours or until patching compound has set.

1.11 MANUFACTURED STONE REPAIR MATERIALS

A. Stone Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.

1. Use formulation that is vapor- and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all types of stone.
2. Formulate patching compounds in colors, textures, and grain to match stone being patched.

B. Cementitious Crack Filler: An ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of stone.

1.12 CLEANING MASONRY, GENERAL

A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.
1.13 REPOINTING MASONRY AND STONE

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints where mortar is missing or where they contain holes.
3. Cracked joints where cracks can be penetrated at least 1/4 inch (6 mm) by a knife blade 0.027 inch (0.7 mm) thick.
4. Cracked joints where cracks are 1/8 inch (3 mm) or more in width and of any depth.
5. Joints where they sound hollow when tapped by a metal object.
6. Joints where they are worn back 1/4 inch (6 mm) or more from surface.
7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
8. Joints where they have been filled with substances other than mortar.
9. Joints indicated as sealant-filled joints.

B. Do not rake out and repoint joints where not required.

C. Pointing with Mortar:

1. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

D. Where repointing work precedes cleaning of existing masonry or stone, allow mortar to harden at least 30 days before beginning cleaning work.

1.14 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry and stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Wash down of equipment used for mixing, storing or moving mortar shall be located in an area that the residue will not be a problem for future landscaping, excavation, underground drainage systems, etc. No wash down shall occur near or into new or existing sanitary or storm drainage lines.

END OF SECTION 04900
SECTION 05120 - STRUCTURAL STEEL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Prefabricated building columns.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittal:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit MR 5.1 and Credit MR 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   3. Product Data for Credit EQ 4.2: For field-applied paints and coatings used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA Method 24) and OTC (Ozone Transport Commission) restrictions. These requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop.
      a. Flat Paints, Coatings, and Primers: VOC content of not more than 100 g/L.
      b. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
      c. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC contents of not more than 250 g/L.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and
spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

2. Store in a manner that will prevent damage from falling objects and soiling from mud, concrete and debris.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.5 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another. If steel arrives in the field without primer One coat of primer shall be applied before rust appears

B. Thoroughly clean steel of rust, scale, dirt, weld flux, weld spatter or other foreign matter before paint is applied.

C. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.6 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:

1. W-Shapes: 60 percent.
2. Channels, Angles: 60 percent.
3. Plate and Bar: 25 percent.
4. Cold-Formed Hollow Structural Sections: 25 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

B. Regional Materials of Steel Products: Provide products that have been fabricated within 500 miles of Project site.
1.7 PRIMER

A. Primer: Comply with Chapter 5, Division 9, Section 09910.

1.8 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Cleaning and touchup painting are specified in Chapter 5, Division 9, Section 09910.
SECTION 05400 - COLD-FORMED METAL FRAMING

1.1 SUMMARY

A. This Section includes the following but is not limited to:

1. Exterior load-bearing wall framing.
2. Interior load-bearing wall framing.
4. Floor joist framing.
5. Roof trusses.
6. Roof rafter framing.
7. Ceiling joist framing.

1.2 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
3. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

1.3 SUBMITTALS

A. LEED Submittal:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

1.4 QUALITY ASSURANCE

A. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
1.5 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

1.6 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

1.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 05400
SECTION 05500 - METAL FABRICATIONS

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead doors and grilles.
4. Steel framing and supports for countertops.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Steel framing and supports (outriggers) for window-washing equipment including mounting brackets and anchorages.
8. Mounting brackets and anchorages for window-washing equipment.
9. Elevator machine beams, hoist beams, and divider beams.
10. Steel shapes for supporting elevator door sills.
11. Steel girders for supporting wood frame construction.
12. Steel pipe columns for supporting wood frame construction.
13. Prefabricated building columns.
15. Metal ladders.
16. Ladder safety cages.
17. Alternating tread devices.
18. Metal ships’ ladders and pipe crossovers.
19. Metal floor plate and supports.
20. Miscellaneous steel trim including loading-dock edge angles.
22. Pipe and downspout guards.
23. Abrasive metal nosings, treads and thresholds.
24. Cast-iron wheel guards.
25. Metal downspout boots.
26. Loose bearing and leveling plates for applications where they are not specified in other Sections.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders and alternating tread devices, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
C. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of loads and stresses within limits and under conditions specified in ICC's International Building Code.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.3 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.5 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

1.6 METAL LADDERS

A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

END OF SECTION 05500
SECTION 05511 - METAL STAIRS

1.1 SUMMARY

A. Section Includes:

2. Industrial-type stairs with steel floor plate or grating treads.
3. Ornamental steel-framed stairs.
4. Steel tube railings attached to metal stairs.
5. Steel tube handrails attached to walls adjacent to metal stairs.
6. Railing gates at the level of exit discharge.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
   b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor is 1.5.
1.3 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.
2. Industrial-Type Stairs: Industrial class.
3. Ornamental Stairs: Architectural class.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500 (cold formed).

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

H. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
I. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

J. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B.

K. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B.

1.6 ABRASIVE NOSINGS

A. Cast-Metal Units: Cast aluminum, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

B. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

1.7 PRECAST CONCRETE TREADS

A. Concrete Materials and Properties: Comply with requirements in Chapter 5, Division 3, Section 03300 for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.

B. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50 by 50 mm) by 0.062-inch- (1.6-mm-) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

1.8 STEEL-FRAMED STAIRS

A. Manufacturers:

1. Alfab, Inc.
2. American Stair, Inc.
3. Sharon Companies Ltd. (The).
4. The University prefers local and regional manufacturers within 500 miles of the campus.

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.
   a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).

1. Steel Sheet: Uncoated cold-rolled steel sheet.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Shape metal pans to include nosing integral with riser.
4. Attach abrasive nosings to risers.

D. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1.9 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: 1-1/2-inch- (38-mm-) square top and bottom rails and 1-1/2-inch- (38-mm-) square posts.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

END OF SECTION 05511
SECTION 06100 - ROUGH CARPENTRY

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring and grounds.
5. Wood sleepers.
7. Plywood backing panels.

1.2 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
5. WCLIB: West Coast Lumber Inspection Bureau.

D. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit EQ 4: For adhesives and composite-wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
1.3 WOOD PRODUCTS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

1.4 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

1.5 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   5. Furring.
B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:

1. Mixed southern pine; SPIB.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

1.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.


1.8 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for
accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

1.9 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Provide necessary blocking at window jambs and heads for attachment of shades and drapes.

END OF SECTION 06100
SECTION 06160 - SHEATHING

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
4. Underlayment.
5. Sheathing joint and penetration treatment.

1.2 SUBMITTALS

A. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit EQ 4: For adhesives and composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.


1.4 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.5 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

1.6 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1.7 WALL SHEATHING


1. Nominal Thickness: Not less than 3/8 inch (9.5 mm).

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

1. Nominal Thickness: Not less than 3/8 inch (9.5 mm).

C. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products:
   a. CertainTeed Corporation; GlasRoc.
   b. G-P Gypsum Corporation; Dens-Glass Gold.
   c. Temple-Inland Inc.; GreenGlass
   d. United States Gypsum Co.; Securock.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

1.8 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.

1. Nominal Thickness: Not less than 1/2 inch (13 mm).
B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.
   1. Nominal Thickness: Not less than 15/32 inch (11.9 mm).

1.9 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.
   1. Nominal Thickness: Not less than 7/8 inch (22.2 mm).

B. Underlayment, General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.

END OF SECTION 06160
SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

1.1 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim.
2. Interior frames and jambs.
3. Stairwork and rails.
4. Flush wood paneling and wainscots.
5. Interior ornamental work.
6. Wood cabinets.
9. Solid-surfacing-material countertops.
10. Laminated-plastic laboratory tops.
11. Closet and utility shelving.
12. Shop finishing of interior woodwork.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit EQ 4.1: For installation adhesives, including printed statement of VOC content.
2. Product Data for Credit EQ 4.4:
   a. For each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.
   b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.
3. Product Data for Credit(s) MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
   a. Include statement indicating costs for each product having recycled content.
4. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.
   a. Include statement indicating costs for each certified wood product.
5. The University encourages the use of regional materials located within a 500 mile radius of the campus. Provide appropriate documentation verifying.

1.3 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

B. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

C. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

D. Regional Certification. Provide documentation of indicating regional certification.

1.4 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: White or Red Oak, Maple, Cherry, rift sawn or cut.

C. Wood Species for Opaque Finish: Any closed-grain hardwood.

D. Wood Products: Comply with the following:

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
E. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Su
   a. Abet Laminati, Inc.
   b. Arborite; Division of ITW Canada, Inc.
   c. Formica Corporation.
   d. Lamin-Art, Inc.
   e. Nevamar Company, LLC; Decorative Products Div.
   f. Panolam Industries International Incorporated.
   g. Westinghouse Electric Corp.; Specialty Products Div.
   h. Wilsonart International; Div. of Premark International, Inc.

G. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:

1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:
   a. Nitric Acid (30 Percent): Moderate effect.
   b. Sulfuric Acid (77 Percent): Moderate effect.
   c. Hydrochloric Acid (37 Percent): Moderate effect.
   d. Phosphoric Acid (75 Percent): No effect.
   e. Acetic Acid (98 Percent): No effect.
   f. Formaldehyde: No effect.
   g. Ethyl Acetate: No effect.
   h. Ethyl Ether: No effect.
   i. Phenol (85 Percent): Moderate effect.
   j. Benzene: No effect.
   k. Xylene: No effect.
   l. Butyl Alcohol: No effect.
   m. Furfural: No effect.
   n. Methyl Ethyl Ketone: No effect.
   o. Sodium Hydroxide (25 Percent): No effect.
   p. Sodium Sulfide (15 Percent): No effect.
   q. Ammonium Hydroxide (28 Percent): No effect.
   r. Zinc Chloride: No effect.
   s. Gentian Violet: No effect.
   t. Methyl Red: No effect.

1. Available Manufacturers:
   a. ABA Industries.
   b. Avonite, Inc.
   d. Formica Corporation.
   e. LG Chemical, Ltd.
   f. Meganite Inc.; a division of the Pyrochem Group.
   g. Nevamar Company, LLC; Decorative Products Div.
   h. Samsung; Cheil Industries Inc.
   i. Swan Corporation (The).
   j. Transolid, Inc.
   k. Wilsonart International; Div. of Premark International, Inc.

2. Type: Standard type or Veneer type made from material complying with requirements for Standard type, as indicated, unless Special Purpose type is indicated.

1.5 FIRE-RETARDANT-TREATED MATERIALS

   A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Section, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1.6 CABINET HARDWARE AND ACCESSORIES

   A. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:
      1. Semi-concealed Hinges for Flush Doors: BHMA A156.9, B01361.
      2. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.

   B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

   C. Back-Mounted Pulls: BHMA A156.9, B02011.

   D. Wire Pulls: Back mounted, stainless steel, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

   E. Drawer Slides: BHMA A156.9, B05091.

   F. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

   G. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
      1. Satin Stainless Steel: BHMA 630. Or Owner specified finish for a specific project.
1.7 MISCELLANEOUS MATERIALS

A. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

B. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

C. Adhesive for Bonding Plastic Laminate: Resorcinol.

1.8 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.

1.9 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Chapter 5, Division 9, Section 09910 for finishing opaque-finished architectural woodwork.

C. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Chapter 5, Division 9, Section 09910 for material and application requirements.

END OF SECTION 06402
SECTION 07115 - BITUMINOUS DAMPPROOFING

1.1 SUMMARY
A. This Section includes the following:
   1. Cold-applied, emulsified-asphalt dampproofing.

1.2 SUBMITTALS
A. LEED Submittal:
   1. Product Data for Credit EQ 4.2: For dampproofing, including printed statement of VOC content.

1.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING
A. Available Manufacturers:
   1. ChemMasters Corp.
   2. Degussa Building Systems; Sonneborn Brand Products.
   3. Henry Company.
   5. Koppers Inc.
B. Trowel Coats: ASTM D 1227, Type II, Class 1.
C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
E. VOC Content: 0.25 lb/gal. (30 g/L) or less.

1.4 MISCELLANEOUS MATERIALS
A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

1.5 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING
A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, 1
fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or 1 trowel
coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not
less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

C. On Unexposed Face of Masonry Retaining Walls: Apply primer and 1 brush or spray
coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

D. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and 1 brush or spray
coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

END OF SECTION 07115
SECTION 07163 - METAL-OXIDE WATERPROOFING

1.1 SUMMARY

A. Section includes:
   1. All exterior walls below grade that enclose rooms and spaces.
   2. Walls below grade in elevator pits.

B. Section includes metal-oxide waterproofing for application to concrete elevator pits and sump pits.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit EQ 4.1: For installation adhesives, including printed statement of VOC content.

1.3 WATERPROOFING MATERIALS

A. Metal-Oxide Waterproofing Compound: A product specifically formulated for waterproofing concrete and masonry substrates; containing pulverized iron and a chemical oxidizing agent to cause the iron particles to rust and grow in size in the presence of water; with VOC content complying with limits of authorities having jurisdiction.
   1. Products:
      a. Euclid Chemical Company (The); Iron Waterpeller.
      b. Metalcrete Industries; Metalcrete Waterproofing.
      c. Specco Industries, Inc.; Speccrete Metallic Waterproofer.

1.4 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
C. Portland Cement: ASTM C 150, Type I.

D. Sand: ASTM C 144.

E. Water: Potable.

1.5 MIXES

A. Metal-Oxide Coats: Add metal-oxide waterproofing compound to portland cement, sand, and water according to manufacturer's written instructions. Blend together with mechanical mixer or by hand to required consistency for each coat.

B. Protection Coat: Field mix protection coat consisting of portland cement and sand as recommended by same manufacturer as metal-oxide waterproofing according to manufacturer's written instructions for application over waterproofing. Measure, batch, and mix materials with potable water. Blend together with mechanical mixer to required consistency.

END OF SECTION 07163
SECTION 07180 – TRAFFIC COATINGS

1.1 SUMMARY

A. Section Includes:

1. Liquid applied waterproofing system.
   a. Toilet rooms, housekeeping closets and all floors containing floor drains, except where located on slab on grade.
   b. Floors (including penetrations) of all mechanical rooms above other areas.

1.2 SUBMITTALS

A. LEED Submittal:

1. Product Data for Credit EQ 4.2: For interior-applied traffic coatings, including printed statement of VOC content.

1.3 MATERIALS

A. Traffic Coatings: Complying with ASTM C 957.

B. VOC Content: Provide traffic coatings, for use inside the weatherproofing system, with VOC content of 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.4 LIQUID APPLIED TRAFFIC COATING

A. Products:

1. Dex-O-Tex/Crossfield Products Corp; M-E Flooring Systems.
2. Neogard, Division of Jones-Blair; Peda-Gard FC.
3. Tremco Incorporated, Sealant/Waterproofing Division; 360/251 NF Pedestrian Deck Coating.

B. Primer: Urethane.

C. Preparatory, Base Coats and Topcoat: Single- or multicomponent, aromatic liquid urethane elastomer.

2. Topcoat: 11 mils min. dry film thickness.

D. Aggregate: Uniformly graded, washed silicon carbide sand of particle sizes, shape, and minimum hardness recommended by traffic coating manufacturer.
SECTION 07210 - BUILDING INSULATION

1.1 SUMMARY

A. The University of New Hampshire requires the following for new construction and retrofits:

1. Energy efficient equipment as determined by these industry standards shall be used, unless exempted on a case by case basis by the UNH Facilities Energy Office. The following order of priority shall address the equipment requirements for this category, based on the most stringent requirements that are specified.

   b. Please reference the current New Hampshire Energy Code as administered by the NH Public Utilities Commission.

2. All building envelope requirements shall adhere to Current New Hampshire State Energy Code Section 5, including insulation, fenestration and doors, and air leakage based on climate zone 5A, with the following exception:

3. All doors that separate a conditioned space from the exterior shall be protected with a vestibule per requirements in Current New Hampshire State Energy Code.

1.2 PRODUCTS

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass-fiber board insulation.
4. Spray polyurethane foam insulation.
5. Vapor retarders.

1.3 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.4 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers:
   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Owens Corning.
   d. Pactiv Building Products.

2. Type X, 15 psi (104 kPa).
3. Type IV, 25 psi (173 kPa).
4. Type VI, 40 psi (276 kPa).
5. Type VII, 60 psi (414 kPa).
6. Type V, 100 psi (690 kPa).

B. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type IV, 25-psi (173-kPa) or Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Manufacturers:
   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Pactiv Building Products.

C. Geotextile-Faced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type IV, 25-psi (173-kPa) or Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.

1. Manufacturers:
   a. Owens Corning.

D. Molded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers:
   a. DiversiFoam Products.
   b. Plymouth Foam, Inc.

2. Type I, 10 psi (69 kPa).
3. Type II, 15 psi (104 kPa).
4. Type VIII, 20 psi (138 kPa).

E. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
1.5 GLASS-FIBER BOARD INSULATION

A. Manufacturers:

1. CertainTeed Corporation.
2. Johns Manville.
4. Owens Corning.

B. Unfaced, Flexible Glass-Fiber Board Insulation: ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics.

1. Nominal density of 1.0 lb/cu. ft. (16 kg/cu. m), thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F (25.7 K x m/W at 24 deg C).
2. Nominal density of not less than 1.5 lb/cu. ft. (24 kg/cu. m) or more than 1.7 lb/cu. ft. (27 kg/cu. m), thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

C. Unfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics.

1. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
2. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
3. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
4. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F (30.5 K x m/W at 24 deg C).

D. Sustainability Requirements: Provide glass-fiber board insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

1.6 GLASS-FIBER BLANKET INSULATION

A. Manufacturers:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
5. Owens Corning.
B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

1.7 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers:
   a. BASF Corporation.
   b. Dow Chemical Company (The).
   c. Gaco Western Inc.
   d. Henry Company.

2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

B. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers:
   a. BaySystems NorthAmerica, LLC.
   b. Demilec (USA) LLC.
   c. Gaco Western Inc.
   d. Icynene Inc.
   e. SWD Urethane Company.

2. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m), thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F (24 K x m/W at 24 deg C).

1.8 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils (0.15 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

B. Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim.
and weighing not less than 25 lb/1000 sq. ft. (12 kg/100 sq. m), with maximum permeance rating of 0.0507 perm (2.9 ng/Pa x s x sq. m).

1. Products:
   a. Raven Industries Inc.; DURA-SKRIM 6WW.

C. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft. (10 kg/100 sq. m), with maximum permeance rating of 0.1317 perm (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively, per ASTM E 84.

   1. Products:
      a. Raven Industries Inc.; DURA-SKRIM 2FR.
      b. Reef Industries Inc.; Griffolyn T-55 FR.

D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

E. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

F. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

G. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

1.9 INSTALLATION, GENERAL

A. Comply with insulation manufacturer’s written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer’s standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
SECTION 07271 - SELF-ADHERING SHEET AIR BARRIERS

1.1 SUMMARY
A. This Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.

1.2 DEFINITIONS
A. ABAA: Air Barrier Association of America.
B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PERFORMANCE REQUIREMENTS
A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1.4 PRECONSTRUCTION TESTING
A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1.5 QUALITY ASSURANCE
A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 PROJECT CONDITIONS
A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.
1.7 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.

1. Available Products:
   a. Carlisle Coatings & Waterproofing; CCW-705.
   c. Henry Company; Blueskin SA.
   e. NEI; AC AirSeal.
   f. Rubber Polymer Corporation; Rub-R-Wall SA.
   g. Tremco, Incorporated; ExoAir 110

2. Physical and Performance Properties:
   a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
   b. Tensile Strength: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
   d. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
   e. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
   g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
   h. Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m); ASTM E 96, Water Method.

1.8 INSTALLATION

A. Install modified bituminous sheets according to air barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air barrier sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

B. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

C. Install air barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air barrier.
1.9 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed to these conditions for more than 30 days.

2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

END OF SECTION 07271
SECTION 07272 - FLUID-APPLIED MEMBRANE AIR BARRIERS

1.1 SUMMARY

A. This Section includes the following:
   1. Fluid-applied membrane air barrier, vapor retarding.
   2. Fluid-applied membrane air barrier, vapor permeable.

1.2 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding or permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1.4 PRECONSTRUCTION TESTING

A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

   1. Owner will engage a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from
environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.7 FLUID-APPLIED MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

1. Available Products:
   a. Elastomeric Modified Bituminous Membrane:
      1) Carlisle Coatings & Waterproofing; Barriseal.
      2) Henry Company; Air-Bloc 06.
      3) Meadows, W. R., Inc.; Air-Shield LM.
      4) Tremco Incorporated; ExoAir.
   b. Synthetic Polymer Membrane:
      2) Henry Company; Air-Bloc 21 or 21S.
      3) Rubber Polymer Corporation; Rub-R-Wall Airtight.

B. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

1. Available Products:
   a. Elastomeric, Modified Bituminous Membrane:
      1) Henry Company; Air-Bloc 07.
   b. Synthetic Polymer Membrane:
      1) Henry Company; Air-Bloc 31 or 33.

2. Physical and Performance Properties:

1.8 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

1.9 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

1.10 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.

2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

END OF SECTION 07272
SECTION 07311 - ASPHALT SHINGLES

1.1 SUMMARY

A. Section Includes:
   1. Asphalt shingles.
   2. Underlayment.
   3. Ice and Watershield.

1.2 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.3 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

   1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by GAF Deck Armor.

1.4 ORGANIC-FELT-REINFORCED ASPHALT SHINGLES


   1. Manufacturers:
      a. Submittals will be considered from the following manufacturers: (Fiberglass shingles may be used only with permission of owner and permission must be applied for in writing.)

         1) Bird.
         2) BP.
         3) CertainTeed Corporation.
         4) GAF Materials Corporation.
         5) Georgia Pacific.
         6) IKO.

   2. Tab Arrangement: Three tabs, regularly spaced.
   3. Strip Size: Manufacturer's standard.
4. Algae and Fungus Resistance: Granules treated to remain free of algae and fungus growth and discoloration for a period of no less than 5 years.
5. Color and Blends: As selected by the University from manufacturer's full range.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

1.5 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226 or ASTM D 4869, Type I, asphalt-saturated organic felts, nonperforated.

B. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.

1. Manufacturers:
   a. Carlisle Coatings & Waterproofing, Inc.
   c. Henry Company.
   d. Johns Manville.
   e. Owens Corning.
   f. Polyguard Products, Inc.
   g. Protecto Wrap Company.

1.6 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

1.7 METAL FLASHING AND TRIM

A. General: Comply with requirements in Chapter 5, Division 7, Section 07620.

1. Sheet Metal: Copper.
1.8 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

C. Metal-Flashed, Open-Valley Underlayment: Install two layers of 36-inch- (914-mm-) wide felt underlayment centered in valley. Stagger end laps between layers at least 72 inches (1830 mm). Lap ends of each layer at least 12 inches (300 mm) in direction to shed water, and seal with asphalt roofing cement. Fasten each layer to roof deck with roofing nails.

1. Lap roof-deck felt underlayment over first layer of valley felt underlayment at least 6 inches (150 mm).

1.9 SNOW GUARDS

A. Install snow guards in strict compliance with the manufacturer's installation and attachment techniques.

B. Space brackets to position fasteners over structural members in accordance with manufacturers instructions.

C. Bracket Spacing:

1. Shingle roof: 24" OC secure into structural roof truss with manufacturers approved fasteners) OMG #14 extra heavy duty fastener XHD installed (4) per bracket)

1.10 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Chapter 5, Division 7, Section 07620.

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

C. Step Flashings: Install with a headlap of 2 inches (50 mm) and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.
D. Open-Valley Flashings: Install centered in valleys, lapping ends at least 8 inches (200 mm) in direction to shed water. Fasten upper end of each length to roof deck beneath overlap.

E. Rake Drip Edges: Install rake drip edge flashings over underlayment and fasten to roof deck.

F. Eave Drip Edges: Along all eves and rakes drip edges to be minimum 0.024” mill finish aluminum sheet, brake formed to provide 5” roof rack flange, and 1 1/2” fascia flange with 3/8” drip at lower edge. Furnish in 8’ or 10’ lengths.

1. Install eave drip edge flashings below underlayment and fasten to roof sheathing.

G. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

1.11 ASPHALT SHINGLE INSTALLATION


B. Only hand nailing permitted. Compressor nailing or stapling may be used only with permission of owner and permission must be applied for in writing.

C. Final Adjustment: Replace any damaged shingles (especially scuffed fiberglass shingles in travel areas) and remove debris from site.

END OF SECTION 07311
SECTION 07315 - SLATE SHINGLES

1.1 SUMMARY

A. Section Includes:
   1. Slate shingles.
   2. Underlayment.
   3. Snow guards.

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

PART 2 - PRODUCTS

2.1 SLATE SHINGLES

A. Slate Shingles: ASTM C 406, Grade S1; hard, dense, and sound; chamfered edges, with nail holes machine punched or drilled and countersunk. No broken or cracked slates, no broken exposed corners, and no broken corners on covered ends that could sacrifice nailing strength or laying of a watertight roof.

B. The university prefers to use regional materials within a 500 mile radius of the campus.

   1. Manufacturers:
      a. Evergreen Slate Company.
      b. Greenstone Slate Company, Inc.
      c. New England Slate Company (The).
      d. U.S. Quarried Slate Products, Inc.
      e. Vermont Structural Slate Company, Inc.
      f. Glendyne Slate.

   2. Thickness: Nominal 1/4 to 3/8 inch (6 to 10 mm).
   4. Size: 10 by 16 inches, with 7 inch reveal.
   5. Nail Holes: Two per shingle.
   7. Color: Match existing.

C. Starter Slate: Slate shingles with chamfered nail holes front-side punched.

   1. Length: Exposure of slate shingle plus head lap.
D. Ridge Slate: Slate shingles fabricated with vertical grain orientation.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.

1. Manufacturers:
   a. Carlisle Coatings & Waterproofing, Inc.
   c. Henry Company.
   d. Johns Manville.
   e. Owens Corning.
   f. Polyguard Products, Inc.
   g. Protecto Wrap Company.

2.3 SNOW GUARDS

A. Snow-Guard Pads: Fabricated copper units, designed to be installed without penetrating slate shingles, and complete with predrilled holes or hooks for anchoring.

1. Manufacturers:
   a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
   b. Berger Building Products.
   c. Zaleski Snow-Guards for Roofs, Inc.

B. Snow-Guard Rails: Units fabricated from metal baseplate anchored to fixed bracket and equipped with two bars unless otherwise designed.

1. Manufacturers:
   a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
   b. Berger Building Products.

2. Brackets and Baseplate: Bronze or brass.
3. Bars: Brass or bronze tubing.

2.4 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in slate-shingle roofing and remain watertight.
C. Slating Nails: ASTM F 1667, copper, smooth shanked, wire nails; 0.135-inch (3.4-mm) minimum thickness; sharp pointed; with 3/8-inch- (10-mm-) minimum diameter flat head; of sufficient length to penetrate a minimum of 3/4 inch (19 mm) into sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

2.5 METAL FLASHING AND TRIM

A. General: Comply with requirements in Chapter 5, Division 7, Section 07620.

1. Sheet Metal: Copper.

B. Fabricate sheet metal flashing and trim to comply with recommendations that apply to design, dimensions, metal, and other characteristics of the item in SMACNA's "Architectural Sheet Metal Manual."

2.6 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

2.7 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Chapter 5, Division 7, Section 07620.

1. Install metal flashings according to recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Apron Flashings: Extend lower flange over and beyond each side of downslope slate shingles and up the vertical surface.

C. Step Flashings: Install with a head lap of 3 inches (75 mm) and extend both horizontally and vertically. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying slate shingle. Fasten to roof deck only.

D. Hip Flashings: Install centrally over hip with lower edge of flashing concealed by butt of overlying slate shingle. Fasten to roof deck.
E. Open-Valley Flashings: Install centrally in valleys, lapping ends at least 8 inches (205 mm) in direction to shed water. Fasten upper end of each length to roof deck beneath overlap.

F. Rake Drip Edges: Install over underlayment and fasten to roof deck.

G. Eave Drip Edges: Install beneath underlayment and fasten to roof deck.

H. Pipe Flashings: Form flashing around pipe penetrations and slate shingles. Fasten and seal to slate shingles.

END OF SECTION 07315
SECTION 07411 - METAL ROOF PANELS

1.1 SUMMARY
A. The university prefers to use regional materials within a 500 mile radius of the campus.
B. Section Includes:
   2. Standing-seam metal roof panels.

1.2 DEFINITIONS
A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.3 PERFORMANCE REQUIREMENTS
A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
C. Energy Performance: Provide roof panels with solar reflectance index not less than 29 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.4 SUBMITTALS
A. LEED Submittals:
   1. Product Test Reports for Credit SS 7.2: For roof panels, indicating that panels comply with solar reflectance index requirement.
   2. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
      a. Include statement indicating costs for each product having recycled content.
B. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.
1. Submit evidence of meeting performance requirements.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: Provide metal roof panels having insulation core material with the following surface-burning characteristics as determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Fire-Resistance Ratings: Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.6 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Recycled Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
3. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
4. Surface: Smooth, flat finish.

B. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat finish.

C. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.

1.7 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of
butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
3. Products:
   a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
   c. Henry Company; Blueskin PE200 HT.
   d. Metal-Fab Manufacturing, LLC; MetShield.
   e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Felts: ASTM D 226, Type I (No. 15), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

1.8 CONCEALED-FASTENER, LAP-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Standing-Seam-Profile, Concealed-Fastener Metal Roof Panels: Formed with raised, curved-top, standing-seam-shaped major rib at panel edge and flat pan between major rib and panel edge.

1.9 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.
C. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

D. Trapezoidal-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.

E. Trapezoidal-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

F. Integral-Standing-Seam Metal Roof Panels: Formed with integral ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and lapping and interconnecting side edges of adjacent panels.

1.10 ACCESSORIES

A. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (900 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets.

B. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

C. Roof Curbs: Fabricated from same material as roof panels, minimum 0.048 inch (1.2 mm) thick; with bottom of skirt profiled to match roof panel profiles, and welded top box and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch- (1.5-mm-) thick, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

1.11 SNOW GUARDS

A. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.
1. Surface-Mounted, Copper, Stop-Type Snow Guards: Bronze-alloy stops designed for attachment to pan surface of copper roof panel using solder.

END OF SECTION 07411
SECTION 07412 - METAL WALL PANELS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:
   1. Formed metal copper wall panels at exterior walls.
   2. Fabricated copper louvers to match metal wall panels.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicate percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
      a. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit MR 5.1 and Credit MR 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
      a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 QUALITY ASSURANCE

A. Custom-Fabricated Sheet Metal Wall Fabricator/Installer Qualifications: Shop that employs skilled workers who custom-fabricate sheet metal work similar to that required for the project and whose products have a record of successful in-service performance with a minimum of three (3) projects similar in scope.

B. Fire-Resistance Ratings: Where indicated, provide metal wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4 PANEL MATERIALS

A. Copper Sheet: ASTM B 370; temper H00, cold-rolled, except where temper 060 is required for forming; not less than 20 oz./sq. ft.
   1. Manufacturer: Revere Copper.
   2. Finish: Natural Copper
B. Approved Fabricators/Installers: Provide shop-fabricated copper panels fabricated and installed by one of the following:

2. Gilbert and Becker.
3. Oak.

END OF SECTION 07412
SECTION 07415 - COMPOSITE WALL PANELS

1.1 SUMMARY
   A. Section includes metal-faced composite wall panels.

1.2 SUBMITTALS
   A. LEED Submittals:
      1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicate percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
         a. Include statement indicating costs for each product having recycled content.
      2. Product Data for Credit MR 5.1 and Credit MR 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
         a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 DEFINITION
   A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS
   A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   B. Delegated Design: Design metal-faced composite wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 QUALITY ASSURANCE
   A. Fire-Resistance Ratings: Where indicated, provide metal-faced composite wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.6 COORDINATION

A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.7 PANEL MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat finish.

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper.

1.8 METAL-FACED COMPOSITE WALL PANELS

A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.

1. Fire-Retardant Core: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Products:

   a. Alcan Composites USA Inc.; Alucobond.
   b. Alcoa Inc.; Reynobond.
   c. ALPOLIC, Division of Mitsubishi Chemical America, Inc.; ALPOLIC or ALPOLIC Copper.

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- (0.50-mm-) thick, coil-coated aluminum sheet facings.

C. Copper-Faced Composite Wall Panels: Formed with 16-oz./sq. ft. (0.55-mm-thick) copper sheet facings.
1.9 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

B. Fasteners:

1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

2. Copper Wall Panels: Use copper, stainless-steel, or hardware-bronze fasteners.

C. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.

END OF SECTION 07415
SECTION 07460 - SIDING

1.1 SUMMARY

A. Section Includes:
   1. Fiber-cement siding.
   2. Fiber-cement soffit.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicate percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
      a. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit MR 5.1 and Credit MR 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
      a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 QUALITY ASSURANCE

A. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

1.4 FIBER-CEMENT SIDING

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

   1. Manufacturers:
      a. CertainTeed Corp.
      b. GAF Materials Corporation.
      c. James Hardie.
1.5 FIBER-CEMENT SOFFIT

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Manufacturers:
   a. CertainTeed Corp.
   b. GAF Materials Corporation.
   c. James Hardie.

1.6 ACCESSORIES

1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.

2. For fastening fiber cement, use stainless-steel fasteners.

1.7 INSTALLATION

A. Install fiber-cement siding and soffit and related accessories.

1. Install fasteners no more than 24 inches (600 mm) o.c.

END OF SECTION 07460
SECTION 07500 - THERMOPLASTIC SINGLE-PLY MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. The work under this Section consists of furnishing and installing all roofing and waterproofing related items as indicated on the drawings and specified herein for a Rhino bond, mechanically attached, reinforced Thermoplastic roof system and includes, but is not limited to, the following:

1. Contractor is to do all roofing work necessary to accommodate all structural, mechanical, plumbing, and electrical penetrations.
2. The installation of all related flashing work to accommodate the new membrane. All flashings shall be installed permanently and concurrently with the roof membrane in order to maintain a water-tight condition as the work progresses. Temporary flashings are not allowed.
3. The drawings indicate and show the limits of construction for this project. The specifications specify materials and work requirements for this project. Both are complimentary to each other and both shall be followed to complete the work.

1.2 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 for definition of terms related to roofing work not otherwise defined in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. FM Listing: Provide sheet membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.

1. Roofing system shall comply with the following:
   a. Fire/Windstorm Classification: Class I 60.
1.4 SUBMITTALS

A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Include plans, sections, and details of the following:
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes (if applicable).

C. Samples for Verification: Of the following products:
   1. 12-by-12-inch (300-by-300-mm) square of sheet roofing, of color specified, including T-shaped side and end lap seam.
   2. 12-by-12-inch (300-by-300-mm) square of walkway pads.
   3. 12-inch (300-mm) length of metal termination bars.
   4. 12-inch (300-mm) length of battens.
   5. 6 insulation fasteners of each type, length, and finish.
   6. 6 roof cover fasteners of each type, length, and finish.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that the roofing system complies with requirements. Upon request, submit evidence of meeting requirements.

F. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.

G. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

H. Maintenance Data: For roofing system to include in the maintenance manuals.

I. Warranty:
   1. Manufacturer: 15 year labor and material, System Warranty.
   2. Contractor: 2 year from date of substantial completion.

J. Inspection Report: Copy of roofing system manufacturer’s inspection report of completed roofing installation.

K. Installation/Membrane fastener layout to conform with FM 1-60, provided by manufacturer.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing roofing similar to that required for this Project and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product.

B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

   1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and slopes indicated.

C. Preconstruction Meeting: Before installing roofing system, conduct conference at Project site to comply with requirements. Notify participants at least 5 working days before conference.

   1. Meet with Owner; Owner’s representative; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review loading limitations of deck during and after roofing.
   4. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
   5. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
   6. Review temporary protection requirements for roofing system during and after installation.
   7. Review roof observation and repair procedures after roofing installation.
   8. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.
   9. Discuss coordination with local fire department, if applicable.
   10. Discuss compliance with owner’s safety procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid materials from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers’ written instructions and warranty requirements.

1.8 WARRANTY

A. Standard Roofing Manufacturer’s Warranty: 15 year labor and material, System Warranty.

B. Special Project Warranty: Submit roofing Installer’s warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including membrane roofing, sheet flashing, and fasteners for the following warranty period:

1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MANUFACTURER’S REPRESENTATIVE

A. A manufacturer’s technical representative shall visit the sites at the initial application of his product and as often as required by the Contractor and Owner’s Representative to ensure the specifications and recommendation are followed.

B. At the completion of the job, the contractor and manufacturer shall each submit their guarantees to the owner. Additionally, they shall submit an Inspection and Maintenance Schedule to the owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. PVC Sheet:
   a. Sarnafil Inc.

2. Membrane, insulation and accessories shall be purchased through the primary membrane manufacturer.

3. TPO Sheet:
2.2 ROOF MEMBRANE

A. PVC Sheet: Uniform, flexible sheet formed from polyvinyl chloride with plasticizers and modifiers, complying with ASTM D 4434, of the following type, grade, thickness, and exposed face color:

1. Sarnafil:
   a. Field Sheet: S327 .060, mechanically attached
   b. Flashing Sheet: G459
   c. Exposed Face Color: White (Energy White)

B. TPO Sheet:
   a. Field Sheet: .060, mechanically attached sheet
   b. Flashing Sheet: .060 TPO
   c. Exposed Face Color: White (Energy White)
   d. Sika plan may be used, if approved.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing material.

1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, thickness, and color as sheet membrane.

C. Bonding Adhesive:

1. Manufacturer's Approved solvent based adhesive.

D. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch (25 mm) wide, roll formed and prepunched.

E. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch (25 mm) wide by 0.05 inch (1.3 mm) thick, prepunched.

F. Fasteners: Factory-coated steel fasteners.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, seam caulking, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.
2.4 WALKWAYS

A. Manufacturer’s walkway pad.

B. Install around four (4) sides of all serviceable equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.

B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Contractor is responsible for using sheet roofing which will not be contaminated by coal tar or asphalt residue. Provide protective ship sheets if required. Contractor will be required to replace membrane damaged by coal tar or asphalt.

3.2 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 THERMOPLASTIC SHEET INSTALLATION

A. Install reinforced thermoplastic sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax for a minimum of 30 minutes.

B. Start installation of sheet in presence of roofing system manufacturer's technical personnel.

C. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
D. Mechanically fasten sheet securely at terminations and perimeter of roofing.

E. Apply roofing sheet with side laps shingled with slope of roof deck where possible.

F. Spread sealant bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.

G. Install adhered thermoplastic sheet and auxiliary materials to tie in to existing roofing

H. Contractor shall make extensive efforts to protect finished membrane from dirt dust and smudge marks by tarping or covering finished sections while demolition operations. Workers should change footwear and/or wear protective “booties” while installing new sheet. Contractor shall clean new membrane at completion of work.

3.4 SEAM INSTALLATION

A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to manufacturer's written instructions to ensure a watertight seam installation. Weld seam as follows:

1. Weld Method: Hot air.

B. Test lap edges with probe to verify seam weld continuity. Apply seam caulk to seal cut edges of sheet membrane.

C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.5 FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.

D. Clean seam areas, overlap sheets, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

E. Test lap edges with probe to verify seam weld continuity. Apply lap sealant and seal exposed edges of sheet flashing terminations.

F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

G. All base flashings are to be fully adhered to underlying substrates with no loose or wrinkled sections. This requirement extends beyond the manufacturers level of acceptance.
3.6 WALKWAY INSTALLATION

A. Walkways: Install walkway pads in locations indicated. Heat weld and adhere walkway pads to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Install around all serviceable equipment (4) sides.

3.7 FIELD QUALITY CONTROL

A. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Owner’s Representative or Owner 48 hours in advance of the date and time of inspection.

3.8 PROTECTING AND CLEANING

A. Protect sheet membrane roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures required by manufacturer of affected construction.

END OF SECTION 07500
SECTION 07531 – EPDM MEMBRANE ROOFING

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:

1. Adhered EPDM membrane roofing system.
2. Vapor retarder.
3. Roof insulation.

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA’s "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight. All roofs shall be fully adhered/mechanically fastened. Ballasted roofing systems are not acceptable.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals’ “RoofNav” for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals’ markings.

1. Fire/Windstorm Classification: Class 1A-90.

D. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency. Energy Performance shall meet or exceed the most current NH energy code requirements.

1.4 SUBMITTALS

A. LEED Submittals:
1. Product Test Reports for Credit SS 7.2: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
2. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project. Minimum experience shall be 10 years.

B. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

C. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

D. Warranty: Shall be 20 years, including 10 years for all workmanship.

1.6 EPDM MEMBRANE ROOFING

A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.

1. Manufacturers:
   a. Carlisle SynTec Incorporated.
   b. Firestone Building Products.
   c. GenFlex Roofing Systems.
   d. Versico Incorporated.

2. Thickness: 60 mils (1.5 mm), nominal.

1.7 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesive: 80 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Nonmembrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.
j. Other Adhesives and Sealants: 250 g/L.

1.8 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
   1. Adhesive: Manufacturer’s standard lap adhesive, FM Approvals approved for vapor-retarder application.

1.9 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 3, felt or glass-fiber mat facer on both major surfaces.
B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

1.10 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer. Walkways shall be provide to all roof mounted equipment from access hatches and doors to the equipment and around the equipment where maintenance and or service is required.

1.11 INSULATION INSTALLATION

A. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1.12 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer’s written instructions. Unroll membrane roofing and allow to relax before installing.
SECTION 07532 - VEGETATED ROOF ASSEMBLIES

1.1 SUMMARY

A. Section Includes:
   1. Tray-type vegetated roof assemblies.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
   2. All selected plants to be native to the region and require no irrigation and do not require active maintenance or chemical input such as fertilizers.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified vegetated roof assembly Installer, approved, authorized, or licensed by membrane roofing manufacturer, whose work has resulted in successful establishment of vegetated roofs.

1.4 VEGETATED ROOF ASSEMBLY COMPONENTS

A. Moisture-Retention and Drainage Products:
   2. Molded-Sheet Drainage Panels: Manufacturer's standard drainage board formed from geotextile-faced, molded-plastic sheet with a geotextile face and "cups" of the molded sheet facing upward like small reservoirs to retain water while allowing excess water to drain away below the board.

B. Aggregate-Type Moisture-Retention and Drainage Products:
   1. Protection Fabric and Drainage Gravel: Manufacturer's standard.

C. Recycled Content: Provide moisture-retention mat and root barrier material with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent by weight.
1.5 VEGETATED ROOF ASSEMBLIES

A. Tray-Type Vegetated Roof Assembly: Modular assembly consisting of manufacturer's standard trays for field-assembly adjacent to and interlocking with each other over membrane roofing.

1. Tray Depth, Nominal: 4 inches.
2. Assembly Weight: Maximum 15 lb/sq. ft. (73 kg/sq. m), including growing medium and plants and saturated with captured water, but not including weight of roofing system.
3. Plantings: ‘GreenGrid™’ recommended design mix of grasses, perennials and groundcovers that will thrive in a non-irrigated, extensive rooftop environment in the Project location. Plants shall be selected according to their USDA hardiness zone classification for New Hampshire. Plants shall be indigenous to New Hampshire or the region and require no special maintenance.
   a. Minimum Planting Density: Plants shall be supplied in minimum size of 3 inch deep by 1.5 inch wide (plugs) and planted in the green roof modules at a rate of not less than 1 per plant/sq. ft.
   b. Recommended Planting Density: Plants shall be supplied in minimum size of 3 inch deep by 1.5 inch wide (plugs) and planted 8 inches o.c.

1.6 MANUFACTURED GROWING MEDIA

A. Growing Medium: Vegetated roof assembly manufacturer's lightweight, manufactured soil mixture designed for plants indicated on Drawings.

1. Manufacturer: Weston Solutions, Inc.

END OF SECTION 07532
SECTION 07620 - SHEET METAL FLASHING AND TRIM

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:
   1. Manufactured Products:
      a. Manufactured reglets and counterflashing.
   2. Formed Products:
      a. Formed roof drainage sheet metal fabrications.
      b. Formed low-slope roof sheet metal fabrications.
      c. Formed steep-slope roof sheet metal fabrications.

1.2 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
   1. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30-lbf/sq. ft. (1.44-kPa) outward force.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance. Minimum experience shall be 10 years.


C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
1.4 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

E. Zinc-Tin Alloy-Coated Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead-soft, fully annealed stainless-steel sheet of minimum uncoated thickness indicated; coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin), with factory-applied gray preweathering.

F. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper, of minimum uncoated weight (thickness) indicated; coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin).

1. Products:
   a. Revere Copper Products, Inc.; FreedomGray.

1.5 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

2. Fasteners for Copper or Zinc-Tin Alloy-Coated Copper Sheet: Copper, hardware bronze or Series 300 stainless steel.

3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

5. Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet: Series 300 stainless steel.

C. Solder:
1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
2. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
3. For Zinc-Tin Alloy-Coated Stainless Steel or Copper: ASTM B 32, 100 percent tin.

1.6 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
   1. Material: Stainless steel, 0.019 inch (0.48 mm) thick.

1.7 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness.

B. Downspouts: Fabricate downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

E. Splash Pans: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

1.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
B. Base Flashing: Fabricate from the following materials:
   1. Copper: 20 oz./sq. ft. (0.68 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft. (0.68 mm thick).

C. Counterflashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

D. Flashing Receivers: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

E. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

F. Roof-Drain Flashing: Fabricate from the following materials:
   1. Copper: 12 oz./sq. ft. (0.41 mm thick).

1.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

B. Valley Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

C. Drip Edges: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

D. Eave, Rake Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

E. Counterflashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).
F. Flashing Receivers: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

G. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).
   2. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft. (0.55 mm thick).

END OF SECTION 07620
SECTION 07720 - ROOF ACCESSORIES

1.1 SUMMARY

A. Section Includes:
   1. Roof curbs.
   2. Equipment supports.
   3. Roof hatches.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.3 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation and mill phosphatized for field painting where indicated.
   1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
   1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

C. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

E. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

1.4 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped
integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers:
   b. Pate Company (The).
   c. Thybar Corporation.

B. Material: Zinc-coated (galvanized) steel sheet

1.5 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers:
   b. Pate Company (The).
   c. Thybar Corporation.

B. Material: Zinc-coated (galvanized)

1.6 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers:
   a. Babcock-Davis.
   b. Bilco Company (The).
   c. Dur-Red Products.
   d. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   e. Pate Company (The).

B. Hatch Material: Zinc-coated (galvanized).

C. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches (1060 mm) above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.

1.7 INSTALLATION

A. Roof Curb Installation: Install each roof curb so top surface is level.

B. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

C. Roof-Hatch Installation:
   1. Install roof hatch so top surface of hatch curb is level.
   2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
   3. Attach safety railing system to roof-hatch curb.

END OF SECTION 07720
SECTION 07810 – CEMENTITIOUS FIREPROOFING

1.1 SUMMARY

A. Section includes sprayed fire-resistant materials (SFRM).
   1. Light density cementitious fireproofing at concealed interior locations.
   2. High density cementitious fireproofing at exposed to view interior and concealed plenum locations.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit EQ 4.2: For paints and coatings, documentation including printed statement of VOC content.

1.3 MATERIALS, GENERAL

A. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Primers, Sealers, and Undercoaters: 200 g/L.
   4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

C. Asbestos: Provide products containing no detectable asbestos.

1.4 ACCEPTABLE PRODUCTS AND MANUFACTURERS

A. Provide one of the following products:
   1. Light Density Cementitious Fireproofing at all interior concealed locations (except plenums):
      b. CAFCO Blaze-Shield II; Isolatek International.
      c. CAFCO 300; Isolatek International.
   2. High Density Cementitious Fireproofing at all exposed interior and plenum locations:
1.5 LIGHT DENSITY CEMENTITIOUS FIREPROOFING

A. Light density cementitious fireproofing for interior concealed conditions (except plenums). Sprayed material shall be factory blended cementitious fireproofing which when mixed at the jobsite with water and applied, will provide compliance with performance test criteria.

1. Density: Not less than 40 lb/cu. ft. and as specified in the approved fire-resistance design, according to ASTM E 605.

2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 0.
   b. Smoke-Developed Index: 0.

1.6 HIGH DENSITY PORTLAND CEMENT BASED CEMENTITIOUS FIREPROOFING

A. High density Portland cement based cementitious fireproofing. Sprayed material shall be factory blended cementitious fireproofing which when mixed at the jobsite with water and applied, will provide compliance with performance test criteria.

1. Density: Not less than 15 lb/cu. ft. (240 kg/cu. m) and 22 lb/cu. ft. (350 kg/cu. m) and as specified in the approved fire-resistance design, according to ASTM E 605.

2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 0.
   b. Smoke-Developed Index: 5.

1.7 AUXILIARY MATERIALS

A. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by fireproofing manufacturer for each fire-resistance design.

   1. Product: Subject to compliance with requirements, provide "Cafco Bond-Seal" by Isolatek International.

B. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

END OF SECTION 07810
SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS

1.1 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

1.2 SUBMITTALS

A. LEED Submittal:

   1. Product Data for Credit EQ 4.1: For penetration firestopping, including printed statement of VOC content and chemical components.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

   1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements." The University will accept only one installer on the project for all trades. Contractor to coordinate all firestopping.

B. Inspections: Shall be conducted weekly with Authority Having Jurisdiction (AHJ), the Durham Fire Department and the Owner. Pictures shall be taken of all areas and recorded in the project record.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

   1. Classification markings on penetration firestopping correspond to designations listed by the following: UL in its "Fire Resistance Directory."

1.4 MANUFACTURERS

A. Manufacturers:
1. Hilti, Inc.
2. 3M Fire Protection Products.

1.5 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-wool-fiber or rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.
5. Steel sleeves.

### 1.6 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

END OF SECTION 07841
SECTION 07920 - JOINT SEALANTS

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Polysulfide joint sealants.
4. Latex joint sealants.
5. Solvent-release-curing joint sealants.
6. Preformed joint sealants.
7. Acoustical joint sealants.

1.2 SUBMITTALS

A. LEED Submittal:

1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

1.3 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

1.4 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

C. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

D. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

E. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.

F. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.

G. Multicomponent, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

H. Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade P, Class 100/50, for Use T.

I. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

J. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1.5 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

C. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
D. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use T.

E. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

F. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

G. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

H. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use T.

I. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

J. Immersible, Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses T and I.


L. Immersible, Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Uses T and I.

M. Immersible, Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T and I.

1.6 POLYSULFIDE JOINT SEALANTS

A. Single-Component, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

B. Multicomponent, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

C. Multicomponent, Nonsag, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

D. Multicomponent, Pourable, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

E. Immersible, Multicomponent, Nonsag, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T and Use I.
1.7 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1.8 SOLVENT-RELEASE-CURING JOINT SEALANTS

A. Acrylic-Based Joint Sealant: ASTM C 1311.

B. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1.9 PREFORMED JOINT SEALANTS

A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

B. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1.10 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1.11 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1.12 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
C. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

END OF SECTION 07920
SECTION 08110 - STEEL DOORS AND FRAMES

1.1 SUMMARY

A. Section Includes:
   1. Standard hollow metal doors and frames.

1.2 SUBMITTALS

A. LEED Submittal:

   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit MR 5.1 and Credit MR 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.3 GENERAL

1. Narrow stile doors shall NOT be allowed.
2. Full length glass doors shall NOT be allowed.
3. Minimum Width: Any door intended for passage by the public shall not be less than 36 inches in width. Exterior doors shall be no less than 36” in height and no less than 7’0” in height.
4. Glazed Lites: Where doors are provided with glazed lites, and do not have a transparent full length sidelite, the bottom edge of the lite shall not be greater than 43 inches above finished floor and shall be glazed with transparent glazing material.
5. Steel Doors with Glass: Provide minimum 4-1/2 inch stiles. Rail shall have a minimum 6 inch, top and bottom rails shall be 8 inch minimum (excluding glass stops). Coordinate midrail locations with push bars and exit devices. All exit devices and push bars, on doors with glass thicker than ½ inch, shall be located behind midrail and coordinated with push bars and exit devices.
6. All steel doors and frames shall be factory-prepped for locks and hardware as prescribed by UNH Hardware Services.
7. Steel doors shall be provided only with prior written authorization of UNH Hardware Services.
8. At least one Exterior Door regardless of construction one door at each accessible entrance shall be equipped with an automatic opener.
1.4 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings Steel Doors shall be a minimum 16 gauge for interior and 14 gauge for exterior.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.5 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.6 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.7 MANUFACTURERS

A. Manufacturers:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
7. Mesker Door Inc.
8. Pioneer Industries, Inc.
10. Steelcraft; an Ingersoll-Rand company.
11. Special-Lite Inc.

1.8 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. Anchors appropriate for wall conditions to anchor framing to wall. A minimum of 5 anchors up to 7’4” on jamb members, and one additional anchor for each foot over 7’4”. Secure head and sill members of transom, sidelites and similar conditions.

1.9 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer’s standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless and) Model 3 (Stile and Rail).
2. Exterior doors shall be insulated.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level: Interior doors exposed to high humidity or high acidity shall be galvanized bearing steel.

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

1.10 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

1. Hinge plates shall be minimum 3/16 inch thick drilled and tapped for 12-24 machine screws. Self-tapping screws are NOT allowed.
2. Steel frames exposed to high humidity, or high acidity areas (such as chicken coops, cow barns) shall be hot-dip galvanized steel.
3. Provide T-anchors at steel frames in masonry.
   1. Fabricate frames as full profile welded.

C. Interior Frames: Fabricated from cold-rolled steel sheet. Steel frames exposed to high humidity or high acidity shall be galvanized steel.
   1. Fabricate frames as full profile welded.
   2. Frames for Level 2 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
   3. Frames for Wood Doors: 0.067-inch- (1.7-mm-) thick steel sheet.
   4. Frames for Borrowed Lights: Same as adjacent door frame.

1.11 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

1.12 FABRICATION

A. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

B. Hardware Preparation: Factory prepare hollow metal work to receive templated hardware; include cutouts, reinforcement, mortising, drilling, and tapping as prescribed by University Hardware Services.
   1. Locate hardware according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

C. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

1.13 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

1.14 WEATHER STRIPPING

A. Shall be Thermal Brush as manufactured by SEALEZE Corporations. Weather stripping shall not be mounted under the door.

END OF SECTION 08110
SECTION 08211 - WOOD DOORS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.
B. Section Includes:
   1. Interior and Exterior Doors
      a. Interior flush-type mineral core fire-rated doors
      b. Non-rated interior flush type solid core wood doors-No particle board cores allowed for Non-rated doors.
      c. Custom Mahogany Entrance Doors.
      d. Solid-core doors with wood-veneer faces.
      e. Factory finishing flush wood doors.
      f. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body
      a. Include statement indicating costs for each certified wood product.
   2. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
C. Forest Certification: Provide doors made with all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

1.4 MANUFACTURERS

A. Interior Door Manufacturers:
   1. Algoma Hardwoods, Inc.
   2. Eggers Industries.
   4. Architectural Door Division.
   5. VT Industries Inc

B. Exterior Door Manufactures: Mahogany
   1. Chautauqua
   2. Harring Doors

1.5 DOOR CONSTRUCTION, GENERAL

A. Interior Doors shall be 1 and ¾” thick. Exterior doors shall be 2 and ¼” thick and shall be coordinated with Chapter 5, Division 8, Section 08411.

B. Exterior Wood Doors shall be used on campus at public entrances to existing buildings where the original doors were wood stile and rail doors. New construction requires consideration review to determine if wood doors are appropriate given the building’s location, use and architectural character.
   1. Exterior doors shall be installed in single door openings, or in double openings do not secure the exterior doors, rather secure the inner vestibule doors, leaving the vestibule unlocked 24/7.
   2. Exterior wood doors in new installations shall be installed in recessed or covered entries at least 4 ft deep. Rain diverters shall be installed as required.

C. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
   1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges. All wood door edge on latchside shall be beveled 1/8” on 2”.
2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

1.6 WOOD-FACED DOORS FOR TRANSPARENT FINISH

A. Exterior Solid-Core Doors:
   1. Wood must be certified from a Sustainable Forest.
   2. Exterior wood doors shall be stile and rail with a horizontal mid-rail at a height appropriate to conceal panic bar hardware, regardless if panic hardware is part of the installation or not at the time. Stiles shall be a minimum of 6” wide, top rail minimum 8” wide and bottom rail minimum 12” wide and center rail minimum 6” wide.
   3. Door frames and sidelites shall be aluminum units. Wood frames shall be considered in limited applications and must be approved in advance by the University.
   4. Grade: Premium, with Grade A faces.
   5. Species: Honduran or African Mahogany. Other wood species may be approved on a project-to-project basis with written University authorization. (Poplar and Red Oak are NOT approved species)
   7. Assembly of Leaves on Door Faces: Balance match.
   8. No surface applied moldings.

B. Interior Solid-Core Doors:
   1. Grade: Premium, with Grade A faces.
   2. Species: White oak, Red Oak, Maple, Ash, Cherry.
   5. Assembly of Veneer Leaves on Door Faces: Balance match.
   6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
   7. Core: Structural solid lumber.
   8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

1.7 LIGHT FRAMES FOR INTERIOR DOORS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
   1. Wood Species: Same species as door faces.
   2. Profile: Manufacturer's standard shape.
   3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

1.8 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Chapter 5, Division 8, Section 08800.

D. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory finishing.

1.9 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

B. Finish doors at factory is required. Color selected by Owner.

1. Factory Finish to be warranted for a minimum of 3-5 years finish and labor.

1.10 INSTALLATION

A. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

B. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 08211
SECTION 08225 – FIBERGLASS REINFORCED POLYMER (FRP) DOORS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.
B. Section includes the following:
   1. Exterior fiberglass reinforced polymer (FRP) doors
   2. Aluminum frames for FRP doors.

1.2 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide Class ‘A’ fiber reinforced polymer faces with the following surface burning characteristics as determined by testing identical products per ASTM E 84 by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 450 or less.

1.3 MANUFACTURERS

A. Manufacturers:
   1. Special-Lite, Inc.
   2. Tubelite, Inc.
   3. Commercial Door Systems.

1.4 MATERIALS

A. Aluminum Members: ASTM B 221 for extrusions and ASTM B 209 for sheet and plate.
B. Steel Reinforcement: ASTM A 36 for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 for hot-rolled sheet and strip.
C. Fiberglass Reinforced Polymer Face Material: 0.120 inch min. thickness, with color integral through full thickness of face sheet. Provide pebble-like embossed finish for flush doors.
D. Core Material: Urethane foam.
E. Fasteners: Aluminum or stainless steel.
1.5 DOORS

A. General: Provide standard flush style embossed panel doors, constructed of aluminum stiles and rails joined with steel tie rods, with polymer face sheets and foamed-in-place urethane inner core.

1. Product: Flush Model SL-17; Special-Lite, Inc.

1.6 FRAMES

A. Frames: Provide tubular extruded aluminum frame members, 2 by 4-1/2 inches or 2 by 6 inches; with minimum 1/8 inch thick walls and closed back. Fabricate with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts. Supply with ½ by 1-1/4 inch door stop, with heavy-duty weathering pile included.

B. Products:

1. Model SL-245 FG (2 by 4-1/2 inch frame); Special-Lite.
2. Model SL-260 FG (2 by 6 inch frame); Special Lite.

END OF SECTION 08225
SECTION 08411 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:

1. Exterior and interior storefront framing.
2. Storefront framing for window walls.
4. Exterior and interior manual-swing entrance doors and door-frame units.

1.2 LEED Submittal:

A. 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
2. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.


1.4 QUALITY ASSURANCE

A. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer’s standard units in systems similar to those indicated for this Project.

B. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.

1. Only Heavy Duty Systems shall be considered for the University of New Hampshire.

C. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines and...
D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.5 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for University’s continued adjustment, maintenance, and removal and replacement of entrance door hardware.

1.6 MANUFACTURERS

A. Manufacturers:

1. EFCO Corporation.
2. Kawneer North America; an Alcoa company.
3. TRACO.
4. Tubelite.

1.7 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

1.8 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Nonthermal for interior locations. Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance for exterior locations.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Storefront Framing: Fabricate components for assembly using screw-spline frame construction, shear-block frame construction or head- and sill-receptor construction with shear-block construction at intermediate horizontal components as recommended by the storefront manufacturer. Provide shear block construction at door frames.

1. Provide thermally broken framing with vertical and horizontal framing members having a nominal face dimension of 2 inches (50 mm), and overall depth of 4-1/2 inches (114.3 mm).
2. Provide minimum 0.118 inch (4.8 mm) thick aluminum framing at door frames.
3. Products:
   a. Model Thermal S-403, with heavy wall entrance door frames for doors; EFCO Corp.
   b. Model VG451T, with heavy wall entrance door frames for doors; Kawneer Company, Inc.
   c. TR-7850 Multi-Glaze Framing System, with heavy wall entrance door frames for doors; TRACO Architectural Systems, Inc.
   d. T14000 Series, with heavy wall entrance door frames for doors; Tubelite Inc.
H. Brake Metal Adapters: Thermally broken extruded aluminum adapter of dimensions indicated with 0.125 inch aluminum break metal matching storefront finish with concealed fasteners.

1.9 GLAZING SYSTEMS

A. Glazing: As specified.

1.10 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer’s standard glazed entrance doors for manual-swing operation.

1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

2. Door Design: Wide stile; 5-inch (127-mm) nominal width.

a. Top Rail: 6-1/2 inches (165.1 mm) wide.
b. Mid Rail: 6 inches (150 mm) wide.
c. Bottom Rail: 10-1/4 inches (260 mm) wide.

3. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.

4. Products:
   a. Durastile Wide Stile; EFCO Corp.
   b. HeavyWall Entrances; Kawneer Company, Inc.
   c. Rugged Stile Entrances; TRACO Architectural Systems, Inc.
   d. Wide Stile Monumental Doors; Tubelite, Inc.

1.11 ENTRANCE DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

B. Opening-Force Requirements:

1. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.

2. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.

C. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
UNIVERSITY of NEW HAMPSHIRE
PLANNING, DESIGN AND CONSTRUCTION GUIDELINES

CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

D. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

E. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

F. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.


H. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

I. Cylinders: As specified in Chapter 5, Division 8, Section 08710.

J. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

K. Operating Trim: BHMA A156.6.

L. Removable Mullions: BHMA A156.3, extruded aluminum.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

M. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.

N. Concealed Overhead Holders: BHMA A156.8, Grade 1.

O. Surface-Mounted Holders: BHMA A156.16, Grade 1.

P. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

Q. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

R. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

S. Silencers: BHMA A156.16, Grade 1.

T. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
U. Finger Guards: Manufacturer’s standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

1.12 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Chapter 5, Division 7, Section 07920.

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

END OF SECTION 08411
SECTION 08520 - ALUMINUM WINDOWS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. This Section includes fixed and operable aluminum-framed windows for exterior locations.

1. Performance Class: HC.
2. Replacement parts shall be readily available.
3. Provide repair kits with necessary special tools and spare parts. Deliver repair kit to University’s Representative.
4. Provide a complete parts list, with prices and ordering information, to the UNH Operations and Maintenance.
5. Provide spare window sashes (equal to 10% of the total windows installed) to the UNH Operations and Maintenance.
6. Provide spare screens (equal to 10% of the total screens installed) to the UNH Operations and Maintenance.

1.2 LEED Submittal:

A. 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
2. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.

1.3 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:

1. AW: Architectural.
2. HC: Heavy Commercial.
3. C: Commercial.
4. LC: Light Commercial.
5. R: Residential.

1.4 QUALITY ASSURANCE

components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1. Provide AAMA-certified aluminum windows with an attached label.

B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA’s "Glazing Manual" unless more stringent requirements are indicated.

C. Warranty: All materials and labor for a period of at least three years from substantial completion.

1.5 MANUFACTURERS

A. Manufacturers who have recently done acceptable projects on campus. Other manufacturers who comply with these standards will be considered.

1.6 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.

1.7 WINDOWS

A. Residence Hall Window Types:

1. Residence Hall Windows: Single hung windows in living units are acceptable, double hung are preferred.
2. Avoid casements, hoppers, or awning units in living units.
3. Provide a night latch feature on all operable sashes that will allow for sash to be secured in place by the occupant, allowing a 6 inch (150 mm) opening.

B. Residence Hall Window Screening:

1. Aluminum Insect Screen Frames: Manufacturer’s standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
2. Compression type frames mounted in aluminum side channels with an angle clip at both sides of the top, fastened to the window frame with tamper-proof screws to secure all screen frames.
3. Exterior screens shall cover only the bottom sash.
4. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3 mm) mesh of 0.011- (0.28-mm) diameter, coated aluminum wire; with black wire-fabric finish. Provide an additional layer of wire fabric on all windows located at grade level.
C. Academic and Administrative Windows:
   1. Operable windows are required in all offices.
   2. Operable windows shall be provided in all classrooms that do not have shoulder season cooling (2 pipe system, chiller shutdown, or other HVAC limitation.)
   3. Fixed units may be used in laboratory spaces, corridors, lobbies, and other specialty spaces.
   4. While double-hung, single-hung, casement or awning units for academic and administrative spaces are acceptable, double-hung are preferred.

D. Academic and Administrative Window Screening:
   1. Sliding Insect Screen Frames: Manufacturer’s standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
   2. Compression type frames mounted in continuous aluminum side channels so they may be easily opened by the occupant.
   3. Screens shall be mounted on the interior on all core campus non-residential buildings. Exterior screens shall cover only the bottom sash on other buildings.
   4. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3 mm) mesh of 0.011- (0.28-mm) diameter, coated aluminum wire; with black wire-fabric finish. Provide an additional layer of wire fabric on all windows located at grade level.

1.8 GLAZING
   A. Glass and Glazing Materials: Refer to Chapter 5, Division 8, Section 08800 for glass units and glazing requirements applicable to glazed aluminum window units.

1.9 HARDWARE
   A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals.

1.10 ALUMINUM FINISHES
   A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   B. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to
exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers’ written instructions.

END OF SECTION 08520
SECTION 08540 – FIBERGLASS WINDOWS

1.1 SUMMARY
   
   A. Under development.
SECTION 08550 - WOOD WINDOWS

1.1 SUMMARY

A. This Section includes fixed and operable wood-framed windows of the following type:

B. Quality: All Windows shall be HC
   1. Unfinished.

C. Warranty: Windows shall be warranted for a period of three years, all parts and labor.

1.2 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
   1. AW: Architectural.
   2. HC: Heavy Commercial.
   3. C: Commercial.
   4. LC: Light Commercial.
   5. R: Residential.

B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
   1. Design pressure number in pounds force per square foot (pascals) used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.3 SUBMITTALS

A. LEED Submittal:
   1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood windows comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
      a. Include statement indicating costs for each certified wood product.
1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations and who is certified for chain of custody by an FSC-accredited certification body.

B. Forest Certification: Provide windows made with not less than 70 percent of wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. Energy: Windows shall meet or exceed the latest NH Energy Code requirements.

1.5 MANUFACTURERS

A. Manufacturers of Unfinished Wood Windows:

1. Cheviot Corporation
3. Crestline; a brand of Peachtree Companies, Inc. (The); TPC Acquisition, Inc.
4. EAGLE Window & Door, Inc.; an American Architectural Products Corporation Company.
5. Hurd Millwork Company.
7. Marvin Windows and Doors.
8. Pella Corporation.
9. Pozzi Custom Collection; JELD-WEN, Inc.
10. Weather Shield Mfg., Inc.

1.6 MATERIALS


B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1.7 WINDOW

A. Window Types:
1. Double-hung.
2. Fixed.
3. Fixed Transoms.

1.8 GLAZING

A. Glass: Clear, insulating-glass units, with low-E coating pyrolytic on second surface or sputtered on second or third surface.

1.9 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with wood; designed to smoothly operate, tightly close, and securely lock wood windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide extruded, cast, or wrought aluminum.

1.10 INSECT SCREENS

A. Provide new screens at lower sash.

1. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire. Wire Fabric Finish: Black.

B. Wood frame shall be painted American/Honduran Mahogany.

1.11 WOOD FINISHES


1. Two coats of finish paint shall be applied in the field.

END OF SECTION 08550
SECTION 08710 - DOOR HARDWARE

1.1 SUMMARY

A. UNH Hardware Services is to receive updated set(s) of prints for all new construction and renovation projects as a cost of the project.

B. "Builders Hardware" includes items known commercially as builder's hardware which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

C. The extent of finish hardware required is indicated on drawings and in schedules.

D. The types of finish hardware required include the following:

1. Hinges.
2. Lock cylinders and keys.
3. Lock and latch sets.
4. Bolts.
5. Exit devices.
6. Push/pull units.
7. Miscellaneous door control devices.
8. Door trim units.
9. Protection plates
10. Weather-stripping for exterior doors
11. Thresholds.

E. Manufacturer: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer, although several may be indicated as offering products complying with requirements.

F. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware in the project's vicinity for a period of not less than 2 years. Supplier must employ an experienced architectural hardware consultant who is available, at reasonable times during the course of the work, for consultation about project's hardware requirements. Supplier must have a warehouse within 100 miles of Durham, NH.

G. Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Chapter 5, Division 1. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish. This material should be marked Confidential, Attention UNH Hardware Services Supervisor.

H. Hardware Schedule: Submit final hardware schedule in the manner indicated as follows. Coordinate hardware with doors, frames and related work to ensure proper size, thickness, hand, function and finish of hardware. Based on finish hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening.
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
DOOR HARDWARE

1. Type, style, function, size and finish of each hardware item.
2. Name and manufacturer of each item.
3. Fastenings and other pertinent information.
4. Location of hardware set cross-referenced to indications on drawings both on floor plans and in door and frame schedule.
5. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.
6. Mounting locations for hardware.
7. Door and frame sizes and materials.

I. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project's construction schedule. Include with schedule the project data, samples, shop drawings of other work affected by finish hardware and other information essential to the coordinated review of hardware schedule. Submit initial draft of schedule along with the essential product data in order to facilitate the fabrication of other work (e.g., hollow metal frame) which is critical in the project construction schedule. Submit final draft of schedule after samples, product data, coordination with shop drawings of other work, delivery, schedules, and similar information has been completed and accepted. Submittals shall be provided to UNH Hardware Services concurrent with Project Manager.

J. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

1. Lock shop will work with owner(s) to set up keying.
2. Contractor shall review keying schedule with UNH Hardware Services prior to issuing keying.

K. Samples: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.

1. Samples will be returned to the supplier. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

L. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

M. Product Handling:

1. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
2. Packaging of Hardware is the responsibility of the supplier. As material is received by hardware supplier from various manufacturers, sort and repack in containers clearly marked with appropriate hardware set number to match set
numbers of approved hardware schedule. Two or more identical sets may be packed in the same container.

3. Inventory Hardware jointly with representatives of the hardware supplier and the hardware installer until each is satisfied that the count is correct.

4. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

5. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

N. Tool and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance and removal and replacement of finish hardware.

O. All locks must meet ANSI specification A156.13 tested and listed for series 1000, Grade 1, operational, grade 2 security. With a five (5) year limited warranty and all locks must be compatible with ASSA Twin 6000 Series. All locks and latches shall be 2 3/4" BS.

1. The Contractor will be responsible for supplying and installing temporary cylinders for all locks for the project and for supplying and installing the permanent cylinders as part of the project.

P. EAS Key Box Standards or currently used key box – Refer to Chapter 5, Division 10, Section 10900.

Q. Building Card Access System:

1. Contractor shall coordinate with UNH Hardware Services and Residential Life for the installation of all card access systems.

2. System purchases shall be consistent with material and equipment used for existing card access to maintain continuity with existing and future card reader projects on the University campus. Residential Life will review and provide assistance to the contractor in the installation and commissioning of all card access systems.

3. Card Access systems shall be coordinated with the electrical subcontractor's work.
2.1 General: Manufacturer's product designations: one or more manufacturers are listed for some hardware types required. Provide either the product designated, or where more than one manufacturer is listed, the comparable product of one of the other manufacturers which comply with requirements including those specified elsewhere in this section, Optional manufacturers shall not be used unless authorization is given in writing by UNH Hardware Services.

2.2 MATERIALS AND FABRICATION

A. Hand of door: drawings show direction of slide, swing or hand of each leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

B. Base Metals: produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated. Do not furnish "OPTIONAL" materials or forming methods for those indicated, except as otherwise indicated.

C. Fasteners: provide hardware manufactured to conform to published templates generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-taping sheet metal screws, except as specifically indicated.

D. Furnish screws: for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces or other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

E. Provide concealed fasteners: for hardware units which are exposed when door is closed, except to extent no standard units of the type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on the opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

2.3 HINGES

A. All hinges shall be steel or solid bronze, ball bearing non radius type. All hinges for exterior doors shall be bronze.
B. The following is a guide for hinge size and type required for this specification:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Exterior</th>
<th>Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3/4&quot; Doors up</td>
<td>Stanley FBB191-4 1/2&quot;</td>
<td>FBB179-4 1/2&quot;</td>
</tr>
<tr>
<td>to 3'0&quot; wide</td>
<td>Hager BB1191-4 1/2&quot;</td>
<td>BB1279-4 1/2&quot;</td>
</tr>
<tr>
<td>1 3/4&quot; Doors</td>
<td>Stanley FBB199-4 1/2&quot;</td>
<td>FBB168-4 1/2&quot;</td>
</tr>
<tr>
<td>over 3'0&quot; wide</td>
<td>Hager BB1199-4 1/2&quot;</td>
<td>BB1168-4 1/2&quot;</td>
</tr>
</tbody>
</table>

C. The width of hinges shall be sufficient to clear all trim.

D. Two hinges shall be provided for each door leaf up to and including five feet (5') in height. An additional hinge shall be required for each additional two and one half (2'6") or fraction thereof in height.

E. All lockable exterior doors, and all lockable out swinging interior doors so indicated in hardware sets, shall be furnished with non-removable pins (NRP). Exceptions are fire, smoke, and stairwell doors.

F. Where listed in hardware sets use Stanley Spring Hinge #2060-R, Hager 1250Refer to finish section for hinge finish.

1. PLEASE NOTE: ALL RESIDENCE HALL DORMITORY ROOMS, WITH FIRE-RATED DOORS, SHALL HAVE SPRING LOADED HINGES.

G. Installation of Stanley Spring Hinges:

1. Spring hinges shall only be mounted on center and/or bottom hinge location (never on top hinge location).

H. Half (1/2) surface hinges shall only be used in Fire, Smoke, Stairwell and Hall Doors.

I. Double Acting Spring Hinges (where required): shall be Bommer type 3029, 3023, 3024. Size to be determined by size and weight of door. Three (3) hinges shall be used. Center hinge shall be placed as close as possible to top hinge for maximum support.

J. Continuous hinges as manufactured by ROTON or Select, are permitted.

2.4 LOCKSETS AND LATCHSETS

A. General: All lever handle locks shall be mortise.

B. All Locksets and Latchsets shall be Lever Handle Mortise - Best 45H Series Heavy Duty with 15H, 14H or 3H trim.

1. Substitution of the following may be used only with written authorization of UNH Hardware Services:

   a. Schlage L Series Heavy Duty, with L03, L06 or L17 trim.
b. Marks Mortise Lock.

C. Locks shall be compatible with room function, manufactured from heavy wrought steel, zinc dichromate finish. Minimum thickness of .093. Locks are to have adjustable armored front. Latchbolts to be with full 3/4” throw. No plastic delrin or eelcon parts will be acceptable. Deadbolts shall be full 1” throw with hardened steel inserts. Strikes are to be made of brass, bronze or stainless steel with a full curved lip.

1. LOCK FUNCTIONS: THE FOLLOWING LIST, ALTHOUGH NOT ALL INCLUSIVE, ADDRESSES MANY LOCK FUNCTIONS USED AT THE UNIVERSITY OF NEW HAMPSHIRE:

   a. Closets F01 Passage
   b. Single person bathrooms F19 Privacy
   c. Offices (indiv. and suites) F04 Office lock
   d. Housekeeping closets F05 Classroom lock
   e. Classrooms F05 Classroom lock
   f. Elec/Mech/Telecom/Elev machine rms. F07 Storeroom lock
   g. Main building entrances F09 Public Entrance
   h. Dorm Rooms (individual and suites) F20 Office lock w/ deadbolt*
   i. Apartments (individual bedrooms) F20 Office lock w/ deadbolt*
   j. Apartments (entry door) F20 Office lock w/ deadbolt*

   * Where electronic access control is not provided.

D. Lock cases to be closed in on all sides to protect inner mechanism from foreign matter. All locksets regardless of trim shall be listed by Underwriters Laboratories for Class A and lesser labeled doors.

E. All trim is to be thru-bolted through the lock case to assure correct alignment and proper operation. Provide knurled tactile warning on trim at doors to hazardous area; coated or surface applied warning is not acceptable.

F. Locksets shall conform to Federal Specifications FFH-106 Series 86 and 87 and be certified as meeting ANSI A156.13 BHMA tested and listed for series 1000, Grade 1, Operational, Grade 2 Security with a five year limited warranty.

G. All locksets and trim are to be made in the U.S.A. this would leave you with only Marks

H. For existing conditions or minor renovations hardware type that is presently existing in the immediate area may be used providing that it meets ADA and UNH Hardware Standards.

2.5 MORTISE DEAD BOLTS

A. Arrow - N Series.

B. Substitution of the following may be used only with the authorization of UNH Hardware Services: Best 48H Series.
2.6 RIM LOCKS

A. Rim locks shall be - Best 44F Series:
   1. 44F74.
   2. 44F79.
   3. 44F77.
   4. No Substitutions shall be allowed.

2.7 AUXILIARY PUSH BUTTON LOCKS

A. Push button locks shall be Schlage L Series.
   1. NOTE: If extra security is required use: Best 38H7R, mounted no higher than 60" form finished floor.
   2. For existing narrow stile doors use 3000 Heavy Duty Access Control Series.

2.8 MORTISE CYLINDERS

A. All mortise cylinders shall be 1 1/4" in length and shall include cylinder rings.

2.9 KEYING

A. The keying system shall be the ASSA TWIN Exclusive, Auxiliary = 2KA723 – 106/51 – TWIN, EXCLUSIVE ACADEMIC = 2KA600 – 227/51 – TWIN, EXCLUSIVE. This is a high security system and total compliance is essential.

B. All cylinders shall be ASSA Twin 6000.
   1. All renovation work shall remain with keying system already in that building.

C. Furnish the following quantities of keys:
   1. Three (3) Master Keys for each Master Key Set.
   2. One (1) Change Keys for each Cylinder. Except mechanical rooms which we would need zero keys.

D. All cylinders, master keys and all change keys shall be sent Registered Mail, Confidential Attention: UNH Hardware Services Supervisor, Leavitt Center, 6 Leavitt Lane, Durham, NH 03824.

E. All keys shall be stamped one side with code number and "Property of University of New Hampshire, Do Not Duplicate". Note: This is not required with ASSA key blanks.

F. Provide one bitting list with combination, and one expansion sheet for no less than 25 rekeys sent, Registered Mail, Confidential, Attention: UNH Hardware Services Supervisor, 6 Leavitt Lane, Leavitt Center, Durham, NH 03824.
G. Provide 200 key blanks stamped "Property of University of New Hampshire, Do Not Duplicate" stamping not required with ASSA key blanks, and side bar code. Provide 25 additional cut keys per master key under next available changes, stamped key and side bar codes.

H. Provide 15 extra cylinders for each style supplied.

2.10 EXIT DEVICES

A. General: All devices shall be "low profile" touch pad type as manufactured by Von Duprin with functions as listed. Horizontal touch pad to be brass, bronze, stainless steel or extruded aluminum construction. Mounting screws to be concealed. All non fire-rated devices shall have cylinder dogging with standard six cylinder keyed to existing system as directed by Owner.

B. All devices are UL listed for casualty.

VON DUPRIN
Sgl. Ext. Dr w/Trim 99L-NL
Sgl. Ext. Dr (exit only) 99EO
Pr. Ext. Dr w/Trim & Mullion 99L-NL
Pr. Ext. Dr EO & Mullion 99EO
Sgl. Int. Dr w/Trim (Fire Rated 1/2 hour) For Fire Rated
Pr. Int. Dr. w/Trim (Fire Rated 1/2 hour) Doors use Von Duprin
Pr. Int. Dr. w/Trim (Fire Rated) 99L-F w/appropriate trim

C. Precision Exit Devices: Series - APEX, is acceptable.

1. Rim Type:
   a. UL Listed 2100 Series.
   b. UL Fire Rated: FL2100 Series.

2. Surface Vertical Rod:
   a. UL Listed 2200 Series.
   b. UL Fire Rated: FL2200 Series.

3. Mortise:
   a. UL Listed 2300 Series.
   b. UL Fire Rated: FL2300 Series.

4. Cylinder dogging shall be used on all UL Apex listings.

5. Outside trim shall be 9L or 9LC.

6. Function as required.

PRECISION - APEX
Sgl. Ext. Cr w/Trim 2103 x 9L/9LC x CD
Sgl. Ext. Dr (Exit only) 2101 x 3 x CD
Pr. Ext. Dr w/Trim & Mullion 103 x 9L/9LC x 811 x CD
Pr. Ext. Dr EO & Mullion 2101 x 3 x 811 x CD
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS

DOOR HARDWARE

7. Finish:
   a. Use US32D.

D. The use of removable mullion on DBL doors whenever possible to minimize the use of vertical rods.

E. No concealed vertical rods shall be used (NO EXCEPTIONS).

F. No other substitutions will be permitted.

2.11 ALARMED EXIT DEVICES

A. Manufacturers: Von Duprin or Precision.

1. Von Duprin – Use 98 or 99 series in stainless steel for rim or mullion latching. Fire rated as applicable.

2.12 EXIT ALARMS

A. Exit alarms for latch side of door, use DETEX EA 501 SERIES.

B. Exit alarms for hinge side of door, use DETEX EX 502 SERIES or equivalent.

C. Hardwired exit alarms shall be DETEX EA2500 SERIES, AC-powered. Surface mounted for new construction or renovations. One door in the building shall have an outside cylinder for deactivation. Door to be determined by the Owner.

2.13 DOOR CLOSERS

A. All door closers shall have fully hydraulic, full rack and pinion action with high strength cast iron cylinders. Checking fluid shall be high lubricity and low pour point. Hydraulic regulation shall be tamper proof, non-critical screw valves adjustable by hex wrench. Closers shall have separate adjustments for latching speed, closing speed and hydraulic back check. All closers shall be of one manufacturer and shall have a minimum of a five (5) year warranty.

1. Closer shall be LCN SERIES 4010, or 4110 SERIES.
2. Fore delayed action use LCN 4010-DEL Series.
3. All exterior doors shall have stop motion by back check or floor stop only. Cush-n-Stop or Cush-n-Stop with hold open shall not be allowed. Door closers shall be installed on the least public side of door.
4. Use parallel arm whenever possible.
5. Provide hold open arms as listed in hardware sets.
6. Provide delayed action closers as listed in hardware sets.
7. Soffit shoe with stop projection shall not be allowed (NO EXCEPTIONS).
8. No concealed floor or jamb mounted closers shall be used.
9. Finish shall be: Painted to match hardware finish.
10. Designer to minimize use of door closers only to locations necessary.
11. Where doors are equipped with closers and also exist across a corridor circulation path which is a part of the accessible route of the building, such doors shall also be equipped with a code-complying hold open device to maintain them in the normally open position.

2.14 PUSH/PULL HARDWARE

A. Push/Pull handles shall be BURNS #8426b OR EQUIVALENT.
B. Push plates shall be BURNS #54X4"X16" OR EQUIVALENT.
C. Offset pull handles shall not be allowed (NO EXCEPTIONS).
D. Flush pull hardware shall not be allowed. Exceptions are sliding closet doors and pocket doors.

2.15 DOOR STOP, BUMPERS AND HOLDERS

A. General: It shall be the responsibility of the hardware supplier to provide door stops for all doors.
B. Floor type bumpers shall be used wherever possible and shall be one of the following:
   1. Ives 436, 438, 436x435, 438x437.
C. Where necessary, determined by door height and floor type use Ives- 444 or 448.

2.16 WALL BUMPERS

A. Where floor type bumpers cannot be used, such as on unreinforced partitions or in situations where door comes in contact with material such as glass, provide wall type stops of the following:
   1. Ives: 443, 447, or 406, 407, 408, 406 1/2, 407 1/2 (must be wrought).

2.17 STOPS AND HOLDERS

A. Use Ives-445, 446, 449, 445, or 452 where possible.
B. Where wall or floor hold opens cannot be used, hold open arm shall be used in conjunction with LCN closers.

C. Hold opens for fire and smoke doors and/or wherever remote control or automatic closing doors are required, recommended manufacturers will be RIXON/FIREMARK-900 SERIES OR EQUIVALENT.

2.18 SILENCERS

A. Unless furnished by metal door frame manufacturer, provide rubber silencers for all interior pressed steel (hollow metal) frames. Silencers shall be pneumatic type 1/2" diameter with 1/8" projection.

B. Manufacturers:

1. Ives 20 series for metal or equivalent.
2. Ives 21 series for wood or equivalent.

C. Provide three (3) silencers for the strike jamb of metal frames for single doors and two (2) for the head for metal frames for pairs of doors.

D. Provide four (4) silencers for the strike jamb for frames for single Dutch doors.

2.19 KICK-MOP ARMOR PLATES

A. Kick plates shall be .050 gauge solid stainless steel 8" high by 1/1/2" less door width for single doors and 1" less door width for pairs of doors except where required by BARRIER FREE DESIGN STANDARDS.

B. Kick plates shall be applied on the push side of all doors where noted.

C. Armor plates shall be .050 gauge solid stainless steel 40" high 1 1/2" less door width for single doors and 1" less door width for pairs of doors.

2.20 THRESHOLDS

A. Thresholds used for exterior doors shall be extruded aluminum as manufactured by Sealeze Corporation; or equivalent.

B. Saddle type where applicable.

C. Latch track type for vertical rod panic hardware.

D. Frost barrier thresholds may be used on exterior doors as manufactured by Reese Enterprises Inc.

E. All thresholds shall have horizontal center supports to prevent sagging.

F. Threshold thickness shall be:
1. Saddle type = .200" minimum.
2. Latch track type = .130" minimum, not to exceed .50".
3. Frost barrier type = .130" minimum.

G. Extruded brass or bronze thresholds may be used only when deemed extremely necessary to meet aesthetic requirements, and must be stuff mounted.

2.21 THRESHOLD HARDWARE

A. Interior shall be lead anchors with sheet metal screws. Thresholds 4 feet wide and less shall have 3 anchor points. Thresholds wider than 4 feet shall have anchors no further apart than 18".

B. Exterior threshold shall be lead anchored with brass/bronze screws, double anchor point – 3 on inner side, 3 on outer side. Same distance as A.

2.22 FINISH

A. With the exception of door closers, "Precision exit devices", thresholds and weatherstripping, all hardware items shall be furnished in US10 finish or US26D finish. Final decision shall be up to the customer as recommended by Campus Planning or the Supervisor of UNH Hardware Services.

1. Please Note: Manufacturer's Standard Gray or Tan are the choices being used at the present time at the University of New Hampshire. Exceptions are as follows:

   a. Door Closers: Sprayed to match finish of the building.
   c. Precision Exit Device: Use US32D.

2.23 POWERED DOOR OPERATORS

A. Manufacturers: LCN, Doromatic, Gyro-tech, or Horton 7000.

1. Provide at least one leaf of the main entrance to a primary facility with a powered door operator. Operators for other doors may be warranted based on building size and entrance proximity to existing accessible routes. Consult with University Affirmative Action Officer where applicable.

2. All powered door operators shall have the ability to operate the doors via a proximity reader, or remote.

3. Door operator buttons shall be separate in the case of pairs of doors in a series.

4. Door operator buttons shall be either square or round, with a minimum 4" diameter or dimension, blue in color, with the international symbol of accessibility displayed unless otherwise specifically approved. All transmitters shall use a 9-volt battery.
5. The maximum total-open time for a door shall be 13 seconds of which a maximum of 5 seconds being held in the fully open position in accordance with ANSI/BHMA A-156.19.

6. Infra-red or motion detecting operators shall only be used with the approval of Facilities Design and Construction, Energy Office, Affirmative Action Office, and UNH Hardware Services.

2.24 ELECTRONIC CARD ACCESS LOCKS

A. GENERAL

1. Electronic Card Access Locks are defined as products that control, monitor, and record the accessibility of University building doors. Electronic card access products can include electric mortise and cylindrical locks, electromagnetic locks, shear locks, electric strikes, card readers, biometric devices, and electronic exit device trim. These products may require supporting products, such as power supplies, interface panels, access control panels, and controllers in addition to software.

2. Determination of the proper hardware requirements is a function of budget, the physical building constraints, the level of security required, features needed for the physical devices, and the budget. The University Housing Department currently employs a networked system for access to residential housing and several other facilities.

3. Any electronic card access system must provide for an EAS Key Box containing access credentials or manual key overrides for the fire, police departments, or safety departments to access the controlled space in the case of emergency.

B. STAND-ALONE COMPUTER PROGRAMMABLE DEVICES

1. General: Defined as units that retain the access information in self-contained memory and do not regularly communicate with any hardware or software controls for other door openings. Stand-alone devices are preferred for existing buildings that were not wired (or are not able to be wired) to be part of a network, or in new construction where the cost implication is too excessive. Access information and programming the locking device is accomplished via either a PDA or laptop (Windows based) with programming cables at each lock.

2. Product Performance Criteria:

   a. Number of users.
   b. Battery Powered.
   c. Available Credentials:

      1) Mag Cards, HID Prox, FOBs, Biometric, Cylinder Override.

3. Features:

   b. User Access Time Zones.
   c. Holiday periods.
4. Products:
   
a. Locknetics/Schlage CM Series (users = 1,000 per, audit = 1,000 events per), Mag Card, Prox., FOB, Keypad, Key Override.

b. Sargent Profile v.G1 Stand Alone Series (users = 2,000 per, audit = 2,000 events per), Mag Card, Prox., FOB, Keypad, Key Override.

c. Persona by Ving Card (users = 1,500 per, audit = 800 events per), Mag Card, Prox., FOB, Keypad, Key Override.

d. Onity Integra (users = 3,000 per, audit = 1,100 events per), Mag Card.

e. Saflok MT (users = 5,000 per, audit = 5,900 events per), Mag Card, Key Override.

f. Kaba Solitaire Prox, (users = 3,000 per, audit = 800 events per), Keypad, Prox., Keypad & Prox, Key Override.

g. Kaba Solitaire Open Architecture (users = 1,000 per, audit = 800 events per), Mag Card, Key Override.

C. Hardware for Card Access: Exit doors in the “Card Access” system shall use either an electric strike, or electrified panic hardware. Electric strikes shall be used in noise is a problem.

1. Electric Strikes: Shall be the HES 9600 or equivalent, for use with panic hardware, for use with other locks use the Von-Duprin 6000 Series, or equivalent.

2. Do not use the Trine 4800.

3. Electric Latch Retraction: Use the Von-Duprin 98/99 Series with the ‘EL’ option, or the Precision 2000 Series with the ‘ELR’ option.

4. Hinges: Use the EPT “Electric Power Transfer” such as Von-Duprin EPT-2, to run wire to the door hardware whenever possible, otherwise use the Hagar, or Stanley, ETQ hinges.

D. NETWORK DEVICES: Defined as units that rely upon a separate intelligent device to ascertain access information (typically a pc or server) for each access occurrence. The devices can be as simple as a card reader controlling an electric strike or electric lock, or a variety of devices connected in a wide area network physically (via wire) or via radio frequency and wiring. New construction is typically required to allow for the planning, wiring, and preparations for the physical connections.

1. The existing network system, administered by University Housing, is a hybrid combination of hard-wired components and RF components. The Server is networked to the Access Control Panels in the building, which are wired directly to card readers, to additional Reader Modules, or wired to other Panel Interface Modules that communicate with Schlage’s Wyreless Access locks.

E. The components of this system are:

1. Network software is C-Cure by Software House running on a Server/Client PC’s.

2. Server/Clients are networked to Access Control Panels.

3. Access Control Panels (ACP) are iStar Pro Sensormatic (Ethernet) by Software House.

4. ACPs are hard-wired to:
a. Software House Integrated Card Readers RM1-MP Sensormatic Electric Strikes are home-runned separately back to the ACP.

b. RM4 Reader Module for Third Party Readers (Weigand) hard–wired to the Card Reader; Electric Strikes are home-runned separately back to the ACP.

c. Panel Interface Modules for the Wyreless Access Locks Supports up to 16 locks per PIM. The PIM uses RF technology to communicate with the Wyreless Access Lock hereby avoiding the wiring from each PIM to each door unit. The access control intelligence resides in the PIM.

d. Wireless Access Lock supports Mag Card, Prox., Key Override credentials communicates with the PIM which determines accessibility of user.

F. Additional Hardware Options:

1. Third Party Card Readers or Locks (wired to the RM4): Any device that supports Weigand protocols should be able to Interface with the RM4 reader

2. Electric Strikes.

G. Competing wired network products that could be utilized in new facilities include:

1. Schlage VIP Open Architecture.


H. Wireless, Networked Card Access offered by Omni Locks allows access control without requiring communication wiring in the building. The three components of the system are:

1. Network software, WAMS (Wireless Access Management Solution), that runs on MS Windows XP Professional (non-server) with SQL database The host computer connects to the Portal Gateways via:
   a. Wireless 802.11G.
   b. Other RF Carriers.
   c. Ethernet 10/100/1000 BaseT.

2. Portal Gateways which support 16, 32, 64, or 128 reader locks per gateway. They are simply an extension of the communication network. Gateways can also connect to other gateways to extend their range.

3. WAMS Reader Locks, which store the access decision data (not stored at the Portal Gateway). WAMS Reader locks support Keypad, Mag Stripe, HID Prox, Mifare Smart Card, contactless RFID card credentials.

4. Individual reader locks can support up to 65,000 users per lock and 89,000 audit events, and contain the Door Switch Monitor, Lock Position Sensor, and REX as part of the lock. Existing or standalone Omnilocks can be upgraded to be Wireless with a field upgrade kit.

END OF SECTION 08710
SECTION 08800 - GLAZING

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
4. Storefront framing.
5. Glazed entrances.
7. Skylights.
8. Interior borrowed lites.

1.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2003 International Building Code by a qualified professional engineer, and by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed design data.

1.3 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.

1.4 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass
is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float
glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float
glass.

C. Thermal and Optical Performance Properties: Provide glass with performance
properties specified, as indicated in manufacturer's published test data, based on
procedures indicated below:

1. Distortion of glass is unacceptable. The exterior lights of all glazing should
appear flat and should not show deflection due to pressurization between the
interior and exterior lights. Select appropriate glass thickness and intermediate
air space to minimize deflection and specify the most current industry standards
for flatness.
2. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
3. For laminated-glass lites, properties are based on products of construction
indicated.
4. For insulating-glass units, properties are based on units of thickness indicated for
overall unit and for each lite.
5. U-Factors: Center-of-glazing values, according to NFRC 100 and based on
LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F
(W/sq. m x K).
6. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values,
according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
7. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

D. Warranty: Provide 10 year minimum warranty on insulated glass units.

1.5 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise
indicated.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with
other requirements specified and with visible light transmission not less than 91
percent.

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless
otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave
distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated
glass).

D. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6,
complying with ANSI Z97.1, Class C.
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
GLAZING

E. Film-Faced Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6 and complying with testing requirements in 16 CFR 1201 for Category II materials.

F. Ceramic-Coated Vision Glass: Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's Tempering Division's "Engineering Standards Manual" and with other requirements specified.

G. On drawings to identify where each color is required. Pyrolytic coatings may be used.

1.6 LAMINATED GLASS

A. ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.


1.7 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1.8 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch (5-mm) nominal thickness.

C. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch (5-mm) nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.

D. Laminated Ceramic Glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch (8-mm) total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials.
E. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.

END OF SECTION 08800
SECTION 09210 - GYPSUM PLASTER

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:

1. Gypsum plasterwork on expanded-metal lath.

C. General:

1. Soft plaster ceiling shall NOT be used.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.

1.3 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.4 EXPANDED-METAL LATH

A. Manufacturers:

1. Dale/Incor.
2. Fry Reglet Corporation.
3. Dietrich Metal Framing; a Worthington Industries Company.
4. Western Metal Lath and Steel Framing Systems.
5. Phillips Manufacturing Co.

1. Recycled Content: Provide steel products with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Paper Backing: Kraft paper factory bonded to back of lath.
3. Diamond-Mesh Lath: Self-furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).

1.5 ACCESSORIES

A. General: Comply with ASTM C 841 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

1. Provide zinc and zinc-coated accessories; G60 (Z180) hot-dip galvanized.

1.6 MISCELLANEOUS MATERIALS

A. Bonding Compound: ASTM C 631.

B. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.

C. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 841.

D. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of rated assembly.
2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

F. Acoustical Sealant:

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.7 BASE-COAT PLASTER MATERIALS

A. Base-Coat Plasters, General: ASTM C 28/C 28M.
1.8 FINISH-COAT PLASTER MATERIALS

A. Gypsum Gaging Plaster: ASTM C 28/C 28M.


C. High-Strength Gypsum Gaging Plaster: ASTM C 28/C 28M, with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C 472 for a neat mix.

D. Gypsum Keene's Cement: ASTM C 61/C 61M.

E. Lime: ASTM C 206, Type N, normal finishing hydrated lime.

1.9 PLASTER MIXES

A. Mixing: Comply with ASTM C 842 and manufacturer's written instructions for applications indicated.

1.10 INSTALLING EXPANDED-METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 841.

2. Horizontal Framing: Install flat diamond-mesh lath.

1.11 PLASTER APPLICATION

A. General: Comply with ASTM C 842.

END OF SECTION 09210
SECTION 09220 - PORTLAND CEMENT PLASTER

1.1 SUMMARY

A. Section Includes:
   1. Interior portland cement plasterwork on metal lath, unit masonry and monolithic concrete.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
      a. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.

1.3 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Sound-Transmission Characteristics: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.

1.4 METAL LATH

   1. Recycled Content: Provide steel products with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
   2. Diamond-Mesh Lath: Self-furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).
B. Paper Backing: FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper or Grade B, Style 1a vapor-retardant paper.

1. Provide paper-backed lath at exterior locations.

1.5 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories: Fabricated from zinc or zinc-coated (galvanized) steel

1.6 MISCELLANEOUS MATERIALS

A. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in portland cement plaster.

B. Bonding Compound: ASTM C 932.

C. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.

D. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

E. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

F. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

G. Acoustical Sealant: As specified in Chapter 5, Division 7, Section 07920.

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.7 PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I, white.

B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
C. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1.8 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork with portland cement mixes.

C. Base-Coat Mixes: Single base coats for two-coat plasterwork with portland cement mixes.


E. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

1.9 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

2. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.

1.10 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

END OF SECTION 09220
SECTION 09250 - GYPSUM BOARD

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regionally manufactured and regionally extracted and manufactured materials. Include statement indicating cost for each regionally manufactured material.
   a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
   b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.
4. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.
5. Laboratory Test Reports for Credit EQ 4: For adhesives used to laminate gypsum board panels to substrates, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
6. Take-Back Plan: Submit a certificate indicating that manufacturer of gypsum board has a corporate plan to take back gypsum scraps, or has a plan to purchase recycled gypsum powder and recycled paper for the production of gypsum board.
1.3 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Provide the following levels of postconsumer recycled content and preconsumer recycled content:

1. Paper Faces: Manufacture paper faces of gypsum board from 100% post-consumer recycled material.
2. Gypsum Powder: Manufacture gypsum board using a minimum of 5% post-consumer, and 26% pre-consumer recycled gypsum powder.
3. Synthetic Gypsum: Minimum 95% recycled content.
4. Steel Framing and Suspension Systems: Provide steel framing and suspension system components with minimum 50% total recycled content.

B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

1.5 INTERIOR GYPSUM BOARD

A. Manufacturers:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
5. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M, 5/8 inch (15.9 mm) thick.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M, 1/2 inch (12.7 mm) thick.

1. Core: 5/8 inch (15.9 mm), Type X.

E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
   1. Core: 5/8 inch (15.9 mm), Type X.

1.6 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
   1. Manufacturers:
      a. American Gypsum.
      b. CertainTeed Corp.
      c. Georgia-Pacific Gypsum LLC.
      e. USG Corporation.
   2. Core: 5/8 inch (15.9 mm), Type X.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
   1. Products:
      a. CertainTeed Corp.; GlasRoc Sheathing.
      b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
      c. National Gypsum Company; Gold Bond, e(2)XP.
      d. USG Corporation; Securock Glass Mat Sheathing.
   2. Core: 5/8 inch (15.9 mm), Type X.

1.7 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
   1. Products:
      a. CertainTeed Corp.; GlasRoc Tile Backer.
      b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
   2. Core: 1/2 inch (12.7 mm), regular type.
B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products:
   a. CertainTeed Corp.; FiberCement Underlayment.
   b. Custom Building Products; Wonderboard.
   c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
   d. USG Corporation; DUROCK Cement Board.

2. Thickness: 1/2 inch (12.7 mm).

C. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers:
   a. American Gypsum.
   b. CertainTeed Corp.
   c. Georgia-Pacific Gypsum LLC.
   d. USG Corporation.

2. Core: 1/2 inch (12.7 mm), regular type.

1.8 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.


1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.

C. Aluminum Trim: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

1. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

1.9 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
4. Tile Backing Panels: As recommended by panel manufacturer.

1.10 AUXILIARY MATERIALS

A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
   1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
   2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      a. Primer and its application to surfaces are specified in other Chapter 5, Division 9 Sections.

END OF SECTION 09250
SECTION 09310 - CERAMIC TILE

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:

1. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
5. Tile backing panels.
6. Metal edge strips.

C. General:

1. Provide ceramic tile floors, ceramic tile or structural glazed tile walls, in all toilet areas.
2. Custom color ceramic tile is not permitted.
3. All floors shall a ceramic tile base with an acid-resistant grout.
4. White grout shall not be used.
5. Bathroom and Shower walls shall have full field tile floor to ceiling unless otherwise specified. Tile walls shall be coordinated with all fixtures and installed hardware so that such installed items coordinate with a full tile. No half tile landings are permitted.

1.2 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.3 SUBMITTALS

A. LEED Submittal:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
1.4 EXTRA MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 1 sq. ft. for each 200 sq. ft. of tile provided.

1.5 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

1.6 TILE PRODUCTS

A. Tile Type: Factory-mounted unglazed and glazed ceramic mosaic tile.

2. Module Size: 2 by 2 inches (50.8 by 50.8 mm).
3. Thickness: 1/4 inch (6.35 mm).
4. Face: Plain with cushion edges.

1.7 THRESHOLDS

A. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

1.8 WATERPROOF MEMBRANE

A. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.

1. Product: Noble Company (The); Nobleseal TS.
1.9 CRACK ISOLATION MEMBRANE

A. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.

1. Product: Noble Company (The); Nobleseal CIS.

1.10 SETTING MATERIALS


1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.

2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.


1. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.11 GROUT MATERIALS

A. Acid Resistant Cement Grout: ANSI A118.6.

B. Grout: ANSI A118.3.

1.12 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F113: Thin-set mortar; TCA F113.
   b. Grout: Polymer-modified sanded grout.

2. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and ANSI A108.1A.
   b. Grout: Polymer-modified sanded grout.

3. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
b. Grout: Polymer-modified sanded grout.

B. Interior Wall Installations, Masonry or Concrete:

   b. Grout: Polymer-modified unsanded grout.

2. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment over cleavage membrane; TCA W244.
   b. Grout: Polymer-modified unsanded grout.

C. Interior Wall Installations, Metal Studs or Furring:

1. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
   b. Grout: Polymer-modified unsanded grout.

D. Shower Receptor and Wall Installations, Concrete or Masonry:

   b. Grout: Polymer-modified unsanded grout.

E. Shower Receptor and Wall Installations, Metal Studs or Furring:

1. Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment; TCA B421.
   b. Grout: Polymer-modified unsanded grout.

END OF SECTION 09310
SECTION 09511 - ACOUSTICAL PANEL CEILINGS

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
   3. Take Back Plan: Submit a certificate indicating that manufacturer of acoustical ceiling components has a corporate plan to take back ceiling tile scraps, or has a plan to purchase recycled ceiling panel materials for the production of new ceiling panels.

1.3 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
   2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 450 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.5 ACOUSTICAL PANELS, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1.6 ACOUSTICAL PANELS

A. Manufacturers:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Do not assume that every combination of fire-resistance rating, classification, pattern, color, light Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
2. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
3. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
4. Type and Form: Type XII, glass-fiber with membrane-faced overlay.

C. Color: White.

D. Edge/Joint Detail: Square or tegular.

E. Thickness: 5/8 inch (16 mm) or 3/4 inch (19 mm).

F. Modular Size: 24 by 24 inches (610 by 610 mm) or 24 by 48 inches (610 by 1220 mm). 24" X 24" are preferred.

1.7 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

1.8 METAL SUSPENSION SYSTEM

A. Manufacturers:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush or Flanges formed with an integral center reveal.

C. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide aluminum caps on flanges.

1. Structural Classification: Heavy-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white.

1.9 INSTALLATION

A. Wall angles shall be mounted so that exposed face is aligned in the same plane as the Tees (this will require cutting a tegular edge into the ceiling panels at the wall). Provide clean tight joints at all corners of suspension system, no overlap or gaps.

B. No exposed fasteners, including pop rivets, except in vertical or sloped soffits, are allowed.

C. Layout ceilings to balance panel widths on opposite sides of each ceiling in both directions. Avoid use of less than ½ width panels wherever possible, but no less than 6 inches in shortest direction.

D. Field cutting of panels shall provide a tegular edge matching factory finish. Provide touchup paint to cut edges of panels.
E. Ceiling panels shall be installed after carpeting and painting is completed, to minimize the absorption of off-gassing from other materials into the ceiling panels.

F. Provide means of locating valves and other items requiring maintenance or access, which are located concealed above ceiling panels. The identification shall be color-coded to match the color coding issued by the University Director of Utilities for heating and plumbing lines.

G. Provide phenolic tags to locate valves and controls above ceiling mechanically attached to ceiling grid.

END OF SECTION 09511
SECTION 09651 - RESILIENT FLOOR TILE

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:

1. Rubber floor tile, rubber stair treads, rubber landing material and rubber nosing
2. Vinyl composition floor tile.
3. Quartz Tile.
4. Concrete Floor Prep.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, sealants and chemical-bonding compounds, including printed statement of VOC content.
2. Product Data for Credit MR 4.1 and 4.2-Recycled content 30% Pre-Consumer Recycled Content, no DEHP no phthalates.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile, base, treads and landing materials: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.5 RUBBER FLOOR TILE AND BASE

A. Manufacturers:

1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
2. Johnsonite.
5. Roppe Corporation, USA.

B. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color or Class I-B, homogeneous rubber tile, through mottled.

C. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.

D. Wearing Surface: Smooth.

E. Thickness: 0.125 inch (3.2 mm).

F. Size: 12 by 12 inches (305 by 305 mm) or 24 by 24 inches (610 by 610 mm).

1.6 VINYL COMPOSITION FLOOR TILE

A. Manufacturers:
   1. Armstrong World Industries, Inc.
   2. Mannington Mills, Inc.
   3. Tarkett, Inc.

B. Tile Standard: ASTM F 1066, Class 1, solid-color tile or Class 2, through-pattern tile.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

1.7 Quart Tile by Altro or owner considered alternate.

1.8 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
      b. Rubber Floor Adhesives: Not more than 60 g/L.

1.9 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
RESILIENT FLOOR TILE

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Concrete Slab Moisture Mitigation: Hydroseal Primer or owner considered alternate for VCT or Quartz Tile installation.

1.10 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
   1. Apply in accordance with the University’s approved finish/wax instructions.

E. Cover floor tile until Substantial Completion.

END OF SECTION 09651
SECTION 09652 - RESILIENT SHEET FLOORING

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:
   1. Rubber sheet floor covering.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit EQ 4.1: For adhesives and chemical-bonding compounds, including printed statement of VOC content.
   2. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
      a. Include statement indicating costs for each product having recycled content.
   3. Product Data for Credit <R 6.0 for rapidly renewable material.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 EXTRA MATERIALS

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents
   Floor Covering: Furnish quantity not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

1.5 RUBBER SHEET FLOOR COVERING

A. Manufacturers:
   1. Johnsonite.
4. R.C.A. Rubber Company (The).

B. Unbacked Rubber Sheet Floor Covering: ASTM F 1859.
   1. Type: Type I (homogeneous rubber sheet) or Type II (layered rubber sheet).

C. Rubber Sheet Floor Covering with Backing: ASTM F 1860.
   1. Type: Type I, homogeneous rubber sheet with backing or Type II, layered rubber sheet with backing.

D. Hardness: Manufacturer’s standard hardness, measured using Shore, Type A durometer per ASTM D 2240.

1.6 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
   1. Use adhesives that have a VOC content of not more than [50 g/L] [60 g/L] when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Seamless-Installation Accessories:
   2. Chemical-Bonding Compound: Manufacturer’s product for chemically bonding seams.
      a. VOC Content: Not more than 510 g/L. when calculated according to 40 CFR 59, Subpart D (EPA method 24).

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer and approved by University.

1.7 CLEANING AND PROTECTION

A. Comply with manufacturer’s written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:
   1. Remove adhesive and other blemishes from floor covering surfaces.
   2. Sweep and vacuum floor coverings thoroughly.
   3. Damp-mop floor coverings to remove marks and soil.
C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
   1. Apply in accordance with University’s written instructions.

E. Cover floor coverings until Substantial Completion.

END OF SECTION 09652
SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:

1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

2. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   a. Include statement indicating costs for each product having recycled content.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 RESILIENT BASE

A. Resilient Base:

1. Manufacturers:
a. Armstrong World Industries, Inc.
b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
c. Johnsonite.
d. Mondo Rubber International, Inc.
e. Musson, R. C. Rubber Co.
f. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
g. Roppe Corporation, USA.


1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous) or Group II (layered).
3. Style: Cove (base with toe) at resilient flooring and straight (flat or toeless) at carpeted areas.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

1.6 RESILIENT STAIR ACCESSORIES

A. Resilient Stair Treads:

1. Manufacturers:
   a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
   b. Johnsonite.
   c. Mondo Rubber International, Inc.
   d. Musson, R. C. Rubber Co.
   e. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
   f. R.C.A. Rubber Company (The).
   g. Roppe Corporation, USA.

B. Resilient Stair Treads Standard: ASTM F 2169.

1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Surface Design:
   a. Class 2, Pattern: Raised-disc design.
3. Manufacturing Method: Group 1, tread with embedded abrasive strips or Group 2, tread with contrasting color for the visually impaired.

C. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.

D. Nosing Height: 1-1/2 inches (38 mm).

E. Thickness: 1/4 inch (6 mm) and tapered to back edge.
1.7 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers:
   a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
   b. Johnsonite.
   c. R.C.A. Rubber Company (The).
   d. Roppe Corporation, USA.

B. Material: Rubber.

1.8 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Cove Base Adhesives: Not more than 50 g/L.
   b. Rubber Floor Adhesives: Not more than 60 g/L.

B. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer and approved by the University.

1.9 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply in accordance with University’s written instructions.

E. Cover resilient products until Substantial Completion.
SECTION 09654 - LINOLEUM FLOOR COVERINGS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:
   1. Linoleum floor tile and sheet flooring.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 6.0: For linoleum flooring, including printed statement of costs for each rapidly renewable material.
   2. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
   3. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
      a. Include statement indicating costs for each product having recycled content.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   2. Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each color, pattern, and type of sheet flooring installed.
1.5 MANUFACTURERS

A. Products:

1. Armstrong World Industries, Inc.
2. Forbo Flooring, Inc.
3. Tarkett Inc.
4. Marmoleum.

1.6 LINOLEUM FLOOR COVERING

A. Floor Tile: ASTM F 2195, Type I, linoleum floor tile with fibrous backing.

1. Nominal Floor Tile Size: 12 by 12 inches (300 by 300 mm), 18 by 18 inches (460 by 460 mm), 20 by 20 inches (500 by 500 mm), or 24 by 24 inches (600 by 600 mm).

B. Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing.

1. Roll Size: In manufacturer's standard length by not less than 78 inches (1980 mm) wide.

C. Thickness: 0.10 inch (2.5 mm).

1.7 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.

1. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer and approved by the University.

1.8 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

1.9 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying liquid floor polish.
   1. Apply in accordance with University’s written instructions.

E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Substantial Completion.

END OF SECTION 09654
SECTION 09680 – CARPET AND CARPET TILE

1.1 SUMMARY

A. Section Includes:
   1. Tufted carpet and carpet tile.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicate percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
      a. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit MR 5.1 and Credit MR 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
      a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   3. Product Data for Credit EQ 4.3:
      a. For carpet, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
      b. For carpet cushion, documentation indicating compliance with testing and product requirements of CRI's "Green Label" program.
      c. For installation adhesive, including printed statement of VOC content.
   4. Reclamation Plan: Submit a certificate indicating that carpet manufacturer has a corporate plan to reclaim carpet scraps and used carpet for recycling into new carpet.

B. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Silver, 37 to 51 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.3 QUALITY ASSURANCE

A. Reclamation Facility shall have the following equipment:
   1. Moisture Content Identifier.
2. Fiber Type Identifier.
3. Carpet Baler.

B. Reclamation facility shall have the ability to generate a certificate of recycling.

C. Demolition Contractor shall stage all carpet material to be recycled as specified by the reclamation facility.

D. Carpet material to be recycled shall be stored in a contained, dry area.

1.4 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.5 TUFTED CARPET AND CARPET TILE

A. Fiber Content: 100 percent nylon 6, 6 or 100 percent nylon 6 or 100% Wool.

B. Dye Method: Solution dyed.

C. Pile Characteristic: Level-loop pile.

D. Density: For high traffic areas, 7,000 oz/cu. yd. or higher.

E. Applied Soil-Resistance Treatment: Manufacturer's standard material.

F. Antimicrobial Treatment: Manufacturer's standard material.

G. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum per ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
5. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
6. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.
7. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.
8. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.
1.6 INSTALLATION ACCESSORIES

A. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.

   1. Use adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1.7 INSTALLATION

A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:

   1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation." No pads allowed.

1.8 Warranty: Minimum 10 years all carpet and backings.

1.9 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
   2. Remove yarns that protrude from carpet surface.

B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 09680
SECTION 09910 - PAINTING

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

   a. Include summary with the number of gallons of each type of paint and actual VOC for use in establishing a VOC budget and actual VOC.

1.4 QUALITY ASSURANCE

A. Products: Comply with MPI standards indicated and listed in “MPI Approved Products List.”

B. Preparation and Workmanship: Comply with requirements in “MPI Architectural Painting Specification Manual” for products and paint systems indicated.
1.5 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 MANUFACTURERS

A. Manufacturers:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.

1.7 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.
1.8 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

1.9 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:
   1. Alkyd Floor Enamel System:
      a. Prime Coat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
      b. Intermediate Coat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
      c. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.

B. CMU Substrates:
   1. Alkyd System:
      b. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
      c. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
      d. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
      e. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

C. Steel Substrates:
   1. Water-Based Light Industrial Coating System:
      c. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5), MPI #153.

D. Wood Substrates: Including wood trim, architectural woodwork, doors, windows, and wood-based panel products.
   1. Institutional Low-Odor/VOC Latex System:
a. Prime Coat: Primer, latex, for interior wood, MPI #39.
c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
d. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5), MPI #147.

E. Gypsum Board and Plaster Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #144.
d. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5), MPI #147.

END OF SECTION 09910
SECTION 10101 - VISUAL DISPLAY SURFACES

1.1 SUMMARY

A. Section Includes:
   1. Chalkboards.
   3. Tackboards.
   4. Sliding visual display units.
   5. Visual display conference units.

1.2 SUBMITTALS

A. LEED Submittal:
   1. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that the product contains no urea formaldehyde.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 CHALKBOARD ASSEMBLIES

A. Porcelain-Enamel Chalkboards: Balanced, high-pressure, factory-laminated chalkboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- (0.53-mm-) thick, porcelain-enamel face sheet with matte finish.
   1. Manufacturers:
      a. Best-Rite Manufacturing.
      b. Claridge Products and Equipment, Inc.
1.5 MARKERBOARD ASSEMBLIES

A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- (0.53-mm-) thick, porcelain-enamel face sheet with high-gloss finish.

1. Manufacturers:
   a. Best-Rite Manufacturing.
   b. Claridge Products and Equipment, Inc.

2. Particleboard Core:  1/2 inch (13 mm) thick; with 0.015-inch- (0.38-mm-) thick, aluminum sheet backing.

1.6 TACKBOARD ASSEMBLIES

A. Natural-Cork Tackboard:  1/4-inch- (6-mm-) thick, natural cork sheet factory laminated to 1/4-inch- (6-mm-) thick particleboard backing.

1.7 SLIDING VISUAL DISPLAY UNITS

A. Vertical-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed-rear visual display panel, and aluminum-framed vertical-sliding panels; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.

1. Manufacturers:
   a. Claridge Products and Equipment, Inc.

2. Type: Tubular frame on four sides. Unit shall be designed to support panels independent of wall.

3. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall height of unit.

4. Sliding Panels: Fabricated from not less than 3/8-inch- (9.5-mm-) thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage.
Fabricate sliding panels with 0.021-inch (0.53-mm) uncoated thickness, porcelain-enamel face sheets.

5. Hardware: Manufacturer's standard, neoprene ball-bearing end rollers, four on each side of each sliding panel. Counterbalance each sliding panel with lead counterweights supported by steel aircraft cable over ball-bearing sheaves; with removable cover plate for access to counterweights. Provide rubber bumpers at top and bottom for each sliding panel.

1.8 VISUAL DISPLAY WALL PANELS


B. Tack Wall Panels: With tackable surface.

1. Linoleum Resilient Homogenous Material: ¼ inch thick, linoleum resilient homogenous sheet, on jute backing, for direct application to wall surface.

1.9 ACCESSORIES

A. Field-Applied Wood Trim.

B. Chalktray: Manufacturer's standard, continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.

C. Map Rail: Satin anodized aluminum.

1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches (25 to 50 mm) wide.

2. End Stops: Located at each end of map rail.

3. Map Hooks: Two map hooks for every 48 inches (1219 mm) of map rail or fraction thereof.

END OF SECTION 10101
SECTION 10155 - TOILET COMPARTMENTS

1.1 SUMMARY

A. The University prefers to use regional materials within a 500 mile radius of the campus.

B. Section Includes:
   1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.3 QUALITY ASSURANCE


B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
   1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).

D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

E. Stainless-Steel Castings: ASTM A 743/A 743M.

F. Zamac: ASTM B 86, commercial zinc-alloy die castings.

1.5 SOLID-POLYMER UNITS

A. Manufacturers:
   1. Bradley Corporation; Mills Partitions.
   2. Comtec Industries/Capitol Partitions.
   4. Global Steel Products Corp.
   5. Santana Products, Inc.
   6. Sanymetal; a Crane Plumbing company.

B. Toilet-Enclosure Style: Ceiling hung.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

   1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
   2. Heat-Sink Strip: Manufacturer’s standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

E. Pilaster Sleeves (Caps): Manufacturer’s standard design; polymer or stainless steel.

F. Brackets (Fittings):

   1. Full-Height (Continuous) Type: Manufacturer’s standard design; stainless steel.

G. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer. Ceiling supports shall be unitstrut.

1.6 ACCESSORIES

A. Hardware and Accessories: Manufacturer’s standard design, heavy-duty operating hardware and accessories.

1.7 FABRICATION

A. Ceiling-Hung Units: Provide manufacturer’s standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

1. Additional floor supports shall be installed if runs and lengths require for a rigid and durable long term solution.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

1.8 INSTALLATION

A. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

B. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

END OF SECTION 10155
SECTION 10431 - SIGNAGE

1.1 SUMMARY

A. This Section includes the following:
   1. Dimensional characters.
   2. Panel signs.
   3. Exterior signage.
   4. Street name signage.

1.2 INTERIOR SIGNAGE, GENERAL

A. In locations where a small renovation is occurring or a small number of signs are required, conform to the existing sign system in that building and not conform to these standards.

B. Permanent room numbering on signs shall be fully incorporated into the Construction Documents for use by the Contractor. Each permanent room number shall be unique and consistent with the University standard numbering system as follows:

   1. Floor Designations: For buildings that have multiple at-grade entrance levels, the lowest level accessible at grade shall be designated Ground Level. For buildings that have a single at-grade level, that level shall be designated Level One. Floors below the lowest at-grade level shall be designated Basement, Sub-Basement, and Sub-Sub-Basement. Floors above shall be designated numerically in order starting with Level One. If there is a partial or secondary level between these primary levels, it shall be designated Intermediate to the level directly below.

   2. Permanent Room/Space Numbering Sequence:
      a. Room numbering shall be assigned by the University prior to completion of construction drawings.
      b. Any changes to room configurations or door locations after completion of construction documents will require University to review and update room numbering as required.
      c. Room numbering on each floor shall be similar to the method used to assign addresses on a street, odd numbers on the left, even numbers on the right in the direction of ascension. This shall provide a sense of direction or movement from one end of the building to the other.
      d. Gaps in the numbering shall occur so that the numbering sequence across a corridor is always ascending. For example, if there are four rooms on the left before there is a room on the right on Level 1, the left-hand rooms shall be numbered 101, 103, 105, and 107. The right-hand room shall be numbered 108 even though it is the first room on that side of the corridor. A series of large rooms shall also include gaps for future subdivisions, similar to street numbering.
      e. Nested rooms (rooms not directly on a corridor, which are entered from another room) shall have the same room number as the lowest numbered
room they are entered from, plus a letter suffix designated in a clockwise sequence around the room. An example is Room 108A is off of Room 108, Room 108AA is off Room 108A.

f. Each building shall be reviewed separately to determine where it is best to start the numbering sequence so that it progresses across the floor as a continuous numbering string. Wing designations are to be used only when room numbering would require numbers higher than 99 or where a continuous numbering string is not practical.

g. Each separate sign type required on the project shall be obtained from a single manufacturer.

3. Non-Assignable Space Such as Corridors, Stairs, Vestibules, and Elevators: These spaces shall be designated ‘00’ with the following suffixes: (the * indicates a letter to differentiate between similar types of spaces on each floor. An example is a corridor on Level 2 would be designated as 200CRA, a second corridor on that floor would be 200CRB).

a. CR* (corridor).
b. ES* (elevator shaft).
c. LB* (lobby).
d. ST* (stairway).
e. VS* (vestibule).

C. Sign details and message schedule shall indicate size, profile, dimensional requirements, and graphic layout of signs and be based on the specific types indicated.

D. Letters and numbers shall be Palatino typeface. Materials, colors, layout, and size shall be approved by the University Architect and shall conform to ADA and NFPA requirements.

E. Interior Signs must be installed prior to the Certificate of Occupancy.

1.3 EXTERIOR SIGNAGE, GENERAL

A. Building signage shall be installed on the building, freestanding signage is not allowed.

B. Building signage text shall be only the name of the building and not the identifying programs, offices, or functions of the building.

C. Building signage shall be placed as close as possible to a building’s main entrance, preferably over the doorway, or at other major entry points, as required.

D. Building signage shall be engraved into an integral component of the building façade or installed as individual aluminum lettering as described herein.

E. See Attachment C for Street Signs.

F. See Attachment D for Wayfinding Signs.

G. See Attachment E for Core Campus Wood Post detail.
1.4 DEFINITIONS


1.5 QUALITY ASSURANCE

1.6 Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1. & Architectural Barrier-Free Design Code for the State of New Hampshire references ADAAG COORDINATION.

A. Coordinate placement of anchorage devices with templates for installing signs.

1.7 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.

D. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils (0.076 mm) with pressure-sensitive adhesive backing, suitable for exterior applications.

1.8 DIMENSIONAL CHARACTERS

A. Manufacturer: The Southwell Company.

B. Type: Individual letter, Upper case only.

C. Cast Characters: Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free of pits, scale, sand holes, and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated. Comply with the following requirements.
1. Character Material: Aluminum; satin polished face; matte sides with 2 coats clear acrylic lacquer.
3. Height: 6 inch typical; larger size when consistent with building scale.
   a. Stud mount (threaded studs and spacers for application to be provided by Installer).
5. Template: Full-size template of entire sign copy proportionally spaced shall be provided with all signs. Template shall indicate the precise location of all studs. Letters shall be keyed to the template to ensure proper location and orientation of all letters.

1.9 PANEL SIGNS
A. Raise encapsulated plaques.
   1. Manufacturers.
      a. Brailliant Touch.
      b. Welch Architectural Signage.
   2. Shall be constructed of acrylic using the following materials.
      a. Acrylic substrate 1/8" thick.
      b. Acrylic letters chemically welded onto substrate.
      c. Tactile Braille.
      d. Polymer Encapsulation of letters and Braille.
B. University Sign Types (See Attachment A for illustrations):
   1. Type A: Permanent room/space sign: 7 by 7 inch, tactile room number and Braille, other graphics on paper insert.
   2. Type B: Permanent room/space sign: 7 by 7 inch, tactile room number, text and Braille, blank paper insert.
   3. Type C: Permanent Information Sign, size varies, tactile text and Braille no tactile graphics, all graphics on paper insert.
   4. Type D: Non-Permanent Information Sign, size varies, no tactile graphics, all graphics on paper insert that shall be computer-printed onto 8-1/2” by 11” or 11” by 17” 40 lb. paper. These shall be used for directional signs, general information, and identification of functions.
   5. Type E: Signs providing NFPA 101 floor level identification within stairways, 12” by 12” one panel frame or 12” by 24” two panel frame, no tactile graphics required.
   6. Type F: Directories, Multiple panel frame with all graphics on paper inserts that shall be computer-printed onto 11” by 17” 40 lb. paper, no tactile graphics. May be used as floor directories that provide a list of floor locations and/or a simple easily read plan of the floor, or a building directory that identifies specific locations of functions and/or people.
7. Type G: Door and Door Frame Identification Tag; metal plate with door identification engraved (similar to equipment I.D. plates). Adhere or mechanically fasten to door frame.

8. Type H: Laboratories or other spaces containing hazardous materials as defined by UNH EH & S shall be provided with a sign Type D.2 below and in addition to the normal room identification signage, for EH & S required room hazard communication postings.

9. Type I: Specialty Identifications or Services; individual letters attached to walls to identify spaces that are named for a person or family, or for identifying a point of service (TICKETS, PERIODICALS, INFORMATION, etc).

10. Type J: Low Level Exit Signs; vinyl applied or stencil painted luminous photo-chemical characters on the corridor side of all doors leading into exit stairs in dormitories.

11. Type K: Vinyl Lettering; identification on exterior service doors, or doors that are alarmed.

C. Signs using other methods of manufacturing may be considered provided durability of finish materials and appearance are equal or better. Student residences require the most abuse-resistant material and require the use of Raised Encapsulated plaques mounted in mechanically fastened aluminum frames. Academic buildings typically require precision cut dimensional copy and Braille insert signs with chemically welded to acrylic, with no aluminum frame.

D. A single manufacturer shall provide all Type A through Type F signs in a specific style. Signs shall be mounted with concealed fasteners, or adhered to glass.

E. Sign company shall provide to the University the software and database(s) to install on the University's computer, and paper to allow the University to produce replacement inserts for each size and type.

F. Changeable Message Insert signs: Fabricate signs to allow insertion of changeable messages in the form of slide-in inserts.

1. Shall be constructed of acrylic using the following materials:
   a. Acrylic substrate 1/8” thick.
   b. Clear acrylic face 1/16” thick.
   c. Spacer 1/32” between substrate and face.

2. Furnish insert material and software for creating text and symbols for computers for University production of paper inserts.


G. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

1. Shall be constructed of acrylic using the following materials.
   a. Acrylic substrate 1/8” thick.
b. Clear acrylic face 1/16" thick.
c. Spacer 1/32" between substrate and face.
d. Acrylic letters inlaid and chemically welded into clear acrylic face.
e. Tactile Braille.

H. Subsurface Copy: Apply minimum 4-mil- (0.10-mm-) thick vinyl copy to back face of clear acrylic sheet forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.

I. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils (0.076 mm) with pressure-sensitive adhesive backing. Apply copy to exposed face of panel sign.

1.10 NO SMOKING SIGNS

A. These shall be installed on the interior stile of each exterior public door leaf. They shall be made of clear adhesive vinyl with white or black lettering selected to contract with the door color. See Attachment B.

1.11 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

1.12 INSTALLATION

A. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
   1. Plaques to be mounted using 3M Very High Bond Isotec tape: provide 90% coverage.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
   1. Two-Face Tape: 3M Very High Bond Isotec tape: provide a minimum coverage of 1" wide adhesive strip around the entire back perimeter.
   2. Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
   3. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces. 90 to 100% coverage.
   4. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and
anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.

5. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

6. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

C. Bracket-Mounted Signs: Provide manufacturer's standard brackets, fittings, and hardware for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.

D. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

1. Flush Mounting: Mount characters with backs in contact with wall surface.
2. Projected Mounting: Mount characters at projection distance from wall surface indicated.

END OF SECTION 10431

ATTACHMENTS:

ATTACHMENT A – Interior Sign Type Illustrations
ATTACHMENT B – No Smoking Sign (Building)
ATTACHMENT C – Street Signs
ATTACHMENT D – Wayfinding Signs
ATTACHMENT E – Core Campus Wood Post
ATTACHMENT F – Panel Signage Post
SIGN TYPE A.1
SIZE: 7" x 7"

COLORS: BORDER - SELECTED BY OWNER
RAISED NUMBERS - APPEARANCE OF FULL THICKNESS COLOR - SELECTED BY OWNER
PAPER - SELECTED BY OWNER

COPY: RAISED ROOM NUMBER - 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
RAISED TEXT - N/A
INSERT TEXT - 5/8" PALATINO. TEXT TO ALIGN WITH ROOM NUMBER.

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE A.2
SIZE: 7" x 7"

COLORS: 
BORDER - SELECTED BY OWNER
RAISED NUMBERS - APPEARANCE OF FULL THICKNESS COLOR - SELECTED BY OWNER
PAPER - SELECTED BY OWNER
COPY: 
RAISED ROOM NUMBER - 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
RAISED TEXT - N/A
INSERT TEXT - 5/8" PALATINO. TEXT TO ALIGN WITH ROOM NUMBER.
MOUNTING: 
SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE A.3
SIZE: 4"x 3 1/2"

COLORS:
- BORDER - N/A
- BACKGROUND - SELECTED BY OWNER
- RAISED NUMBERS - APPEARANCE OF FULL THICKNESS COLOR - SELECTED BY OWNER
- PAPER - N/A

COPY:
- RAISED ROOM NUMBER - 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
- RAISED TEXT - N/A
- INSERT TEXT - N/A

MOUNTING:
- SEE MOUNTING DETAIL 1

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE A.4

SIZE: 7"x 3"

COLORS:  
BORDER - N/A
BACKGROUND - SELECTED BY OWNER
RAISED NUMBERS - APPEARANCE OF FULL THICKNESS COLOR - SELECTED BY OWNER
PAPER - N/A

COPY:  
RAISED ROOM NUMBER - 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
RAISED TEXT - N/A
INSERT TEXT - N/A

MOUNTING:  
SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE B.1

SIZE: 7" x 7"

COLORS:
- BORDER: SELECTED BY OWNER
- RAISED NUMBERS AND TEXT: APPEARANCE OF FULL THICKNESS COLOR: SELECTED
- PAPER: SELECTED BY OWNER

COPY:
- RAISED ROOM NUMBER: 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
- RAISED TEXT: 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
- INSERT TEXT: N/A

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE C.1

SIZE: 7"x 7"

COLORS: BORDER - SELECTED BY OWNER
RAISED TEXT - APPEARANCE OF FULL THICKNESS COLOR - SELECTED BY OWNER
PAPER - SELECTED BY OWNER

COPY: RAISED ROOM NUMBER - N/A
RAISED TEXT - 1" PALATINO WITH TACTILE PLATE, RAISED 1/32"
INSERT TEXT - N/A

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE C.2
SIZE: AS INDICATED ON SCHEDULE

COLORS:  BORDER - SELECTED BY OWNER
          RAISED TEXT - APPEARANCE OF FULL THICKNESS COLOR - SELECTED BY OWNER
          PAPER - SELECTED BY OWNER
COPY:  RAISED ROOM NUMBER - N/A
       RAISED TEXT - 5/8" PALATINO WITH TACTILE PLATE, RAISED 1/32"
       INSERT TEXT - N/A
MOUNTING:  SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
LEVEL ONE

Collection Development 131
Government Document 120
Group Study Rooms 121 - 125
Technical Services 133
Copier
Restrooms 111, 115

SIGN TYPE D.1

SIZE: AS INDICATED ON SCHEDULE

COLORS:
- BORDER - SELECTED BY OWNER
- RAISED NUMBERS AND TEXT - N/A
- PAPER - SELECTED BY OWNER

COPY:
- RAISED ROOM NUMBER - N/A
- RAISED TEXT - N/A
- INSERT TEXT - SEE SCHEDULE

MOUNTING:
SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 4.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE D.2

SIZE: 9 1/2" x 12" (accepts 8 1/2" x 11" paper inserts.)

COLORS:  
- BORDER - SELECTED BY OWNER
- RAISED NUMBERS AND TEXT - N/A
- PAPER - SELECTED BY OWNER

COPY:  
- RAISED ROOM NUMBER - N/A
- RAISED TEXT - N/A
- INSERT TEXT - NONE

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE D.3

SIZE: 7”x 7”

COLORS: BORDER - SELECTED BY OWNER
         RAISED NUMBERS AND TEXT - N/A
         PAPER - SELECTED BY OWNER

COPY: RAISED ROOM NUMBER - N/A
      RAISED TEXT - N/A
      INSERT TEXT - NONE

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE E.1

SIZE: 24"x 12"

COLORS:
- BORDER - SELECTED BY OWNER
- PERMANENT TEXT - SELECTED BY OWNER
- PAPER - SELECTED BY OWNER

COPY:
- PERMANENT TEXT:
  - LEFT PANEL - PALATINO 1", 5/8", 3-3/4" AND 1/2"
  - RIGHT PANEL - HEADER, PALATINO 1".
- INSERT TEXT: RIGHT PANEL - PALATINO 1/2".

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SOUTH STAIR
LEVEL 2
Serves Levels G Thru 3
Emergency Exit Level G ▼
No Roof Access

SCALE: 3" = 1'-0"

SIGN TYPE E.2
SIZE: 12"x 12"

COLORS: BORDER - SELECTED BY OWNER
PERMANENT TEXT - SELECTED BY OWNER
PAPER - SELECTED BY OWNER
COPY: PERMANENT TEXT - PALATINO 1", 5/8", 3-3/4" AND 1/2"

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; AND TYPICAL MOUNTING ELEVATION 3.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE F.1
SIZE: ONE PANEL - 12" x 18"

COLORS:
- BORDER - SELECTED BY OWNER
- PAPER - SELECTED BY OWNER

COPY: INSERT TEXT - SEE SCHEDULE.
MOUNTING: SEE MOUNTING DETAIL 1 AND 2; TO BE CENTERED ON WALL.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE F.2a

SIZE: TWO PANEL - 24"x 18"

COLORS: BORDER - SELECTED BY OWNER
         PAPER - SELECTED BY OWNER
COPY: INSERT TEXT - SEE SCHEDULE.
MOUNTING: SEE MOUNTING DETAIL 1 AND 2; TO BE CENTERED ON WALL.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE F.2b
SIZE: TWO PANEL - 18"x 24"

COLORS: BORDER - SELECTED BY OWNER
        PAPER - SELECTED BY OWNER
COPY: INSERT TEXT - SEE SCHEDULE.
MOUNTING: SEE MOUNTING DETAIL 1 AND 2; TO BE CENTERED ON WALL.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE F.3

SIZE: THREE PANEL - 36"x 18"

COLORS: BORDER - SELECTED BY OWNER
         PAPER - SELECTED BY OWNER

COPY: INSERT TEXT - SEE SCHEDULE.

MOUNTING: SEE MOUNTING DETAIL 1 AND 2; TO BE CENTERED ON WALL.

University of New Hampshire Durham, New Hampshire
June, 2010
SIGN TYPE G
SIZE: 3/4" x 2 1/2"
COLOR: SELECTED BY OWNER
COPY: TITLE - 1/8" PALATINO. DOOR NUMBER - 1/4" ENGRAVED.
MOUNTING: SEE ABOVE.

University of New Hampshire Durham, New Hampshire
June, 2010
MOUNTING DETAILS
1 AND 2

University of New Hampshire
Durham, New Hampshire

June, 2010
Mounting elevation – typical door plaque

MOUNTING ELEVATION 3

University of New Hampshire
Durham, New Hampshire

June, 2010
PLEASE NO SMOKING

YOU MUST BE AT LEAST 20 FEET AWAY FROM ANY BUILDING
UNIVERSITY OF NEW HAMPSHIRE

PLANNING, DESIGN AND CONSTRUCTION GUIDELINES

UNIVERSITY OF NEW HAMPSHIRE

→ LEAVITT SERVICE CENTER

→ CAMPUS

→ FIELD HOUSE

→ Parking Lot A

→ BARTON HALL

→ GRANT HOUSE Admissions

→ Visitor Information

→ SERVICE BLDG.

→ PAUL CREATIVE ARTS CENTER

SIGN TYPE #2

SCALE 3"=1'-0"

SIGN TYPE #3

SCALE 3"=1'-0"

UNIVERSITY of NEW HAMPSHIRE

Durham, New Hampshire

Typ for All Signs

Cal. Cut MGP, MGP or Blue Pgs 300 or 400

Dye Sublimation

1. Exact size & location of each sign to be determined at the Field of the campus

2. All copy panels must be "Trico" white or 3/4" high

3. All arrows to be Center General

Colors:

Issued by:

CONSTRUCTION

Facilities Design & Construction

Approved by:

Date:

Project Mgr.

Architect

Client

Fire Dept.

Safety

Project Number:

Project Name:

UNH STANDARDS

DRAWING TITLE:

CAMPUS SIGNAGE

Scale: 1/4" = 1'-0"

Drawn by: SN

Checked by:

Date: Oct. 16, 2001

Drawing No. 10431 Attachment D-1
ENGINEER GRADE REFLECTIVE WHITE VINYL LETTERING, PALATINO FONT

SEE POST SECTION DETAIL BELOW

3/4" BLACK PVC PANEL WITH ARDYN HIGH PERFORMANCE VINYL FILM ET - COLOR 17 SAPPHIRE BLUE (OR MATCH BLUE PMS #288 FINISH) ON FRONT AND BACK OF PANEL. MATCH PANEL CONSTRUCTION TO THE SIGN AT ARTS WAY AND ACADEMIC WAY

4X4 WOOD POST - FIR, PRIMED AND PAINTED WITH RONAN PAINT (OR EQUAL) - COLOR 156 BRILLIANT BLUE (OR MATCH BLUE PMS #288 FINISH). MATCH POST CONSTRUCTION TO THE SIGN AT ARTS WAY AND ACADEMIC WAY

SLOT TO ACCEPT SIGN PANEL. MATCH CONSTRUCTION TO THE ARTS WAY AND ACADEMIC WAY SIGN. SECURE PANEL TO POST USING STAINLESS STEEL SCREWS

DRAWING TITLE: ALTERNATE WITH WOOD POSTS

SCALE: 1" = 1'-0"

DRAWN BY: 5TH
CHECKED BY: DD
DATE: APR 27, 2012
DRAWING NO. 10431 Attachment F-1
SECTION 10522 - FIRE EXTINGUISHER SPECIALTIES

1.1 SUMMARY

A. Section Includes:
   1. Fire protection cabinets for the following:
      a. Portable fire extinguishers.
   2. Fire extinguishers.
   3. Signage.

1.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
   2. Extruded Shapes: ASTM B 221 (ASTM B 221M).

C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

1.3 FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket.

   1. Manufacturers:
      b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
      c. Larsen's Manufacturing Company.
      d. Potter Roemer LLC.

   2. Multi-Purpose Dry Chemical Type in Steel Container: UL-rated 3-A;40:B:C, 5-lb (2.3 kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

1.4 MOUNTING BRACKETS

A. Mounting Brackets: manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall. Of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
1.5 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers:
   b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
   c. Larsen's Manufacturing Company.
   d. Potter Roemer LLC.

B. Cabinet Construction: As required.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch or projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, or concealed hinge permitting door to open 180 degrees.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following: Color by Architect.
a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
b. Interior of cabinet and door.

L. Signage:
1. Decals applied to cabinet, Red Vertical.

1.6 FABRICATION

A. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

1.7 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction and as indicated below.

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

END OF SECTION 10522
SECTION 10801 - TOILET AND BATH ACCESSORIES

1.1 SUMMARY

A. Section Includes:
   1. Washroom accessories.
   2. Shower room accessories.
   3. Warm-air dryers.
   4. Childcare accessories.
   5. Custodial accessories.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.4 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.


E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
MISCELLANEOUS SPECIALTIES

SECTION 10900 – MISCELLANEOUS SPECIALTIES

1.1 SUMMARY
   A. Section Includes:
      1. Key lock boxes.

1.2 PRODUCTS
   A. Product: Knox Box.

1.3 INSTALLATION
   A. All key lock boxes used for University keys, or mounted on University property, shall be flush-mounted.
   B. Location shall be coordinated with Durham Fire Department and Architect.

END OF SECTION 10900
1.5 WASHROOM ACCESSORIES

A. Manufacturers:
   1. A & J Washroom Accessories, Inc.
   2. American Specialties, Inc.
   5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
   6. Tubular Specialties Manufacturing, Inc.
   7. Rubbermaid.

B. Toilet Tissue (Roll) Dispenser: Furnished by University, Installed by Contractor.

C. Paper Towel (Roll) Dispenser: Furnished by University, Installed by Contractor.

D. Waste Receptacle: Freestanding. Rubbermaid

E. Liquid-Soap Dispenser: Furnished by University, Installed by Contractor.

F. Grab Bar:
   3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
      a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
   4. Outside Diameter: 1-1/2 inches (38 mm).

G. Vendor:
   2. Type: Sanitary napkin and tampon.
   3. Mounting: Fully recessed, designed for 4-inch (100-mm) wall depth.
   5. Lockset: Tumbler type with separate lock and key for coin box.

H. Sanitary-Napkin Disposal Unit:

I. Mirror Unit:
   2. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.

1.6 WARM-AIR DRYERS

1.7 CHILDCARE ACCESSORIES

A. Product: Model KB100-00; Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.

1.8 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder:
   2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
   3. Length: 36 inches (914 mm).
   5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
      a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
      b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

1.9 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to University.

1.10 INSTALLATION

A. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

1.11 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801
SECTION 11132 - PROJECTION SCREENS

1.1 SUMMARY

A. Section Includes:
   1. Manually operated projection screens.
   2. Electrically operated projection screens and controls.
   3. LCD projector Mounts.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Final layouts of screens and projector mounts shall be coordinated with the University Audio Visual Services Department, the Architect and the Contractor.

1.3 MANUALLY OPERATED PROJECTION SCREENS

A. General: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.

   1. Screen Mounting: Top edge securely anchored to a 3-inch- (75-mm-) diameter, rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.

   2. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling.

B. Surface-Mounted, Metal-Encased, Manually Operated Screens: Units designed and fabricated for surface mounting on wall or ceiling, fabricated from formed-steel sheet not less than 0.027 inch (0.7 mm) thick or from aluminum extrusions; with flat back design and vinyl covering or baked-enamel finish. Provide units with matching end caps and concealed mounting.

   1. Product: Draper Inc.; Access / Series M.

1.4 ELECTRICALLY OPERATED PROJECTION SCREENS

A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete
installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling.

B. Suspended, Electrically Operated Screens with Automatic Ceiling Closure: Motor-in-roller units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.

1. Products: Draper Inc.; Signature/Series V.
2. Provide metal or metal-lined wiring compartment on units with motor in roller.
3. Screen Case: Made from metal.

1.5 SCREEN MATERIAL

A. Matte-White Viewing Surface: Peak gain not less than 0.9, and gain not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.

1. Product for Manually-Operated Units: Draper Inc.; Fiberglass Matte White.
2. Product for electrically-Operated Units: Draper Inc.; M1300.


END OF SECTION 11132
SECTION 11135 – AUDIO/VISUAL EQUIPMENT

1.1 SUMMARY

A. Section Includes:

1. Offset ceiling plates.
2. Suspended ceiling projector mounting kit.
3. Coordination of ceiling plates and projector mounting kits shall be field coordinated with University Audio Visual Services, the Architect and the Contractor.

1.2 OFFSET CEILING PLATES

A. Product: Model CMA-330 Offset Ceiling Plate; Chief Manufacturing (www.chiefmfg.com).

1.3 SUSPENDED CEILING KIT

A. Product: Model CMA-450 Suspended Ceiling Kit; Chief Manufacturing (www.chiefmfg.com).

END OF SECTION 11135
SECTION 12491 - HORIZONTAL LOUVER BLINDS

1.1 SUMMARY

A. Section Includes:
   1. Horizontal louver blinds with aluminum slats.

B. General: All window treatments shall be approved by University Facilities Design and Construction prior to purchase.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.3 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Manufacturers:
   2. Levolor Contract; a Newell Rubbermaid company.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
   1. Width: 1 inch (25 mm).
   2. Thickness: Not less than 0.008 inch (0.20 mm).

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.
   1. Capacity: One blind per headrail unless otherwise indicated.
   2. Manual Lift Mechanism:
      a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
      b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.

E. Lift Cords: Manufacturer's standard braided cord.

F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
   1. Type: Braided cord.

G. Valance: Two slats.

1.4 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

1.5 INSTALLATION

A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

   1. Locate so exterior slat edges are not closer than 2 inches (51 mm) from interior faces of glass and not closer than 1-1/2 inches (38 mm) from interior faces of glazing frames through full operating ranges of blinds.
   2. Install mounting and intermediate brackets to prevent deflection of headrails.
   3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
SECTION 12492 - VERTICAL LOUVER BLINDS

1.1 SUMMARY

A. Section Includes:
   1. Vertical louver blinds with PVC vanes.

B. General: All window treatments shall be approved by University Facilities Design and Construction prior to purchase.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.3 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Vertical Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and finish indicated, but no fewer than two units.

   2. Vanes: Furnish quantity of full-size units equal to 5 percent of quantity installed for each type, size, texture, pattern, and finish indicated, but no fewer than two units.

1.4 VERTICAL LOUVER BLINDS, PVC VANES

A. Manufacturers:

   2. Levolor Contract; a Newell Rubbermaid company.

B. Vanes: Lead-free, UV-stabilized, integrally colored, opaque, permanently flexible, extruded PVC that will not crack or yellow; with not less than 3/8-inch (9.5-mm) overlap when vanes are rotated fully closed.

   1. Width: 3-1/2 inches (89 mm).
   2. Profile: Crowned.
3. Flame-Resistance Rating: Comply with NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Headrail: Channel, formed steel or extruded aluminum with long edges returned or rolled and ends capped. Headrail encloses operating mechanisms including carrier-spacing mechanism that provides uniform vane spacing when blinds are traversed fully across headrail (closed).

D. Carriers: Engineered plastic with gears to align and synchronize vane rotation and stems that allow vane removal and replacement. Lead carriers have self-lubricating wheels or elongated bearing surfaces; following carriers have self-lubricating wheels.

1.5 VERTICAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate vertical louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

1.6 INSTALLATION

A. Install vertical louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior vane edges are not closer than 2 inches (51 mm) from interior faces of glass and not closer than 1-1/2 inches (38 mm) from interior faces of glazing frames through full operating ranges of blinds.

END OF SECTION 12492
SECTION 12494 - ROLLER SHADES

1.1 SUMMARY

A. Section Includes:
   1. Manually operated roller shades with single rollers and with double rollers.

B. General: All window treatments shall be approved by University Facilities Design and Construction prior to purchase.

1.2 SUBMITTALS

A. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.3 MANUFACTURERS

A. Manufacturer: MechoShade Systems, Inc.

1.4 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Bead Chains: Nickel-plated metal or stainless steel.
      a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.
   1. Crank-Handle Type: Detachable.

C. Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer's standard pull.
1. Pole: Manufacturer's standard type in length required to make operation convenient from floor level and with hook for engaging pull.

D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

F. Shadebands:
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

G. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
   2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
   3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
   4. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
   5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.

1.5 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

   1. Bead Chains: Nickel-plated metal or stainless steel.
      a. Loop Length: Full length of roller shade.

      a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criteria are more stringent.
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
ROLLER SHADES

B. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.
   1. Crank-Handle Type: Detachable.

C. Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer’s standard pull.
   1. Pole: Manufacturer’s standard type in length required to make operation convenient from floor level and with hook for engaging pull.

D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

G. Inside Shadebands:
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

H. Outside Shadebands:
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

I. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
   2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
   3. Endcap Covers: To cover exposed endcaps.
   4. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
   5. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
6. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.

7. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.

1.6 DOUBLE, ELECTRICALLY-OPERATED SHADES

A. Coordinate with other trades, electrical, BAS and Crestron for proper operation and control.

B. Ensure coordination with other trades for supports of motors, controls millwork to ensure a seamless installation.

1.7 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.


1.8 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

1.9 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer’s written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.

END OF SECTION 12494
SECTION 14210 – ELECTRIC TRACTION ELEVATORS

1.1 SUMMARY

A. This Section includes electric traction passenger and service elevators.

1.2 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with ASME A17.1.

B. Seismic Performance: Provide elevators capable of withstanding the effects of earthquake motions determined according to the requirements of the Building Code of New Hampshire.

C. Accessibility Requirements: Comply with Section 407 in ICC A117.1.

D. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

1.4 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include periodic preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

B. Perform maintenance, including emergency callback service, during normal working hours.

C. Include 24-hour-per-day, 7-day-per-week emergency callback service.

D. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
1.5 MANUFACTURERS

A. Product Elevators: Subject to compliance with requirements, provide gearless traction elevators as manufactured by Otis Elevator Co., as specified in Elevator Schedule at the end of this Section, or comparable by one of the following:

1. Kone Ecospace
2. ThyssenKrupp Elevator.
3. Otis Gen II Elevator
4. Or owner considered and approved comparable.

B. Signal Fixtures and Equipment shall be manufactured by PTL Equipment Mfg. Co.

C. Controllers shall be manufactured by Elevator Equipment Corporation, Motion Control Engineering, Inc., or G.A.L. Manufacturing Corporation.

1.6 DESCRIPTION OF EQUIPMENT

A. Car Top Inspection Station: Yes.

B. Emergency Car Lighting: Yes.

C. Emergency Operation: Fireman’s Service – Phase I and II, with Barrel-Key FE 01.

D. Floor Designations: Enter per UNH Scheme (e.g. B1, B, G, 1, 2, 3, . . .).

E. Independent Service: Key switch by elevator contractor; ASSA 6000 high security cylinder, provided and keyed by Owner.

F. Keyed Lockout:

1. In-car for Levels: All Attic and mechanical rooms shall include In-Car lock out, cylinder by ASSA 6000, keyed per UNH Hardware Services. {Indicate In-Car Lock-out Levels (e.g. None, Level B, etc.)}.

2. Key switches by elevator contractor; ASSA 6000 high security cylinder, provided and keyed by Owner.

G. Sills: Extruded Aluminum.

H. Isolation: Yes.

I. Rail Backing: Comply with seismic code requirements.

J. Casing: Yes.

K. Cylinder: Yes, with PVC protection.

L. Plunger: Yes.

M. Wiring Diagrams: Provide with O&M Manuals.
N. Mechanical Drawings and Cuts: Provide with submittals; include with O&M manuals.

O. Documentation: Provide three (3) complete bound sets of O&M Documentation for all materials and products incorporated into the elevator construction. Refer to Chapter 5, Division 1, Section 01100, if applicable, for more information.

P. Special Features:

1. Disabilities Act (ADA); comply with current guidelines.
2. Car Door Full Length Detection Device.
3. Two-Way Communication, one touch auto dial, built-in; EMS brand preferred.
5. Tank Heater to maintain temperature of oil at minimum of 100 degrees.
6. Battery backup for controlled descent to lowest level of egress in event of power loss; with relay(s) as needed to allow interruption by shunt trip when initiated by heat detector activation.
7. Key switches for in-cab light, fan, hold-open features – cylinders by ASSA.

1.7 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
3. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
4. Stainless-Steel Bars: ASTM A 276, Type 304.
5. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
8. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications and Type BKV for panel backing.

1.8 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:

2. Capacity: Minimum 4000 lbs, but must meet stretcher dimensions requirements of IBC 2006 or current code.
3. Floor Finish: Specified in Chapter 5, Division 9 Sections.
4. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
5. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Plastic-Laminate Wall Panels: Plastic laminate with manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
7. Fabricate car with recesses and cutouts for signal equipment.
8. Fabricate car door frame integrally with front wall of car.
10. Sight Guards: Provide sight guards on car doors.
11. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
12. Luminous Ceiling: Fluorescent light fixtures, T-8 lamps program start ballast, 3500 Kelvin temp lamps 80% CRI or better and ceiling panels of translucent acrylic or other permanent rigid plastic.
13. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

1.9 HOISTWAY ENTRANCES
A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
4. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.

1.10 ELEVATOR SCHEDULE
A. Model: GEN2®; as manufactured by Otis Elevator.
1. Type: Gearless traction.
2. Machine Location: Hoistway; no machine room is provided.
3. Rated Load: 2,500 lb (1135 kg).
4. Rated Speed: 350 fpm (1.8 m/s).
5. Operation System: Selective collective automatic operation or Group automatic operation.

B. Car Enclosures:

1. Front Walls (Return Panels): Satin stainless steel, No. 4 finish.
2. Car Fixtures: Satin stainless steel, No. 4 finish.
4. Reveals: Satin stainless steel, No. 4 finish.
6. Door Sills: Aluminum, mill finish.
7. Ceiling: Luminous ceiling.
8. Handrails: ½ by 2 inches (13 by 50 mm) rectangular satin stainless steel, No. 4 finish, at sides and rear of car.

C. Hoistway Entrances: As follows:

1. Type: Single-speed side sliding.
2. Frames: Satin stainless steel, No. 4 finish.
3. Doors: Satin stainless steel, No. 4 finish.
5. Hall Fixtures: Satin stainless steel, No. 4 finish.
6. Additional Requirements:
   a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.

END OF SECTION 14210
SECTION 14240 - HYDRAULIC ELEVATORS

1.1 SUMMARY

A. The work in this Section consists of all labor, materials, equipment and services necessary to complete the work of this Section, and without limiting the generality thereof includes:

1. The installation of oil-hydraulic elevator(s), including transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation even though not specifically mentioned or indicated on the Drawings, but which are usually provided or are essential for proper operation.
2. Furnish and maintain hoistway equipment, operating personnel and rigging to perform the work of this Section.
3. In all cases where a device or part of the equipment is referred to herein in the singular, it is intended that such reference shall apply to as many devices as required to complete the installation.

B. The General and Supplementary Conditions of the Contract and Chapter 5, Division 1 requirements shall apply to the work under this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Principal classes of work related to the work of this Section are listed below, and shall be provided under other specification sections. This listing may not include all related work items and it is the responsibility of the Contractor to coordinate fully the work of this Section with that of all other trades.

1. General

a. Provision of a dry, safe location for storage of the elevator materials.
b. Accommodations for placement of equipment for drilling jack hole and removal of spoils from drilling operation.
c. Provision of loose, dry sand fill around the elevator jack casing.
d. Provision of fire-rated hoistway(s) and machine room(s). Construction may be masonry, gypsum wallboard on light gauge metal studs, or some combination thereof, as shown or specified elsewhere.
e. Provision of fire sealing at all penetrations through fire-rated construction.
f. Provision of barricades and protection of hoistway during the time the elevator equipment is being installed.
g. Cutting of walls, floors, and partitions, together with any repairs made necessary thereby. Provision of recesses in walls and floors to receive doors, sills, and signal equipment such as indicators, push buttons, hall lanterns, etc.
h. Installation of in all inserts as shown on the approved elevator Shop Drawings.
i. Protection of all finished installed work until substantial completion of project, including installation of protective coverings at hoistway entrances.

j. Construction of code-compliant machine room(s) with ventilation, disconnect switches, light switches, 110-volt breakers for car lights, a 15-pound fire extinguisher, and fire-rated doors/frames (see Doors/Frames/Hardware requirements).

k. Construction of code-compliant elevator pit(s) and sump pump system(s) (see Mechanical requirements).

l. Grouting of the underside of thresholds at all elevator landing entrances.

2. Miscellaneous Metal

a. Steel support angles for thresholds of each hoistway opening.

b. Steel ladder for each elevator pit.

c. Mechanically-fastened, flush, plate steel, sectional sump pit cover (free draining).

d. Steel interfacing between guide rail brackets and building structure.

3. Waterproofing and Dampproofing

a. Waterproofing of elevator pit(s), if shown or specified.

4. Doors/Frames/Hardware

a. Provision of 3'-0" min. x 7'-0", fire-rated door(s) and frame(s) (B-Labeled).

b. Provision of door hardware complying with University Standards and including storage function lockset, hinges, closer, and armor plate (on inside face). Also, provision of door sweep and weatherstripping at interior and exterior doors.

5. Finishes

a. Flooring in the elevator car by Architect.

6. Mechanical

a. Code-compliant ventilation and/or air conditioning of hoistway(s) and machine room(s).

b. Where building is served by a sprinkler system, provision of sprinkler coverage in machine room and hoistway with separate branch lines for the top of each shaft, the bottom of each shaft, and each machine room. All branch lines to include isolation valve with flow sensing and tamper switches.

c. Provision of a package automatic sump pump with oil-sensing cut-out; to include 115V UL-listed pump and control systems capable of pumping water while containing oil. The system shall function automatically and shall provide for an alarm and separate LED lights in the event of (a) the presence of oil in the sump, (b) high liquid in the sump, or (c) high amps or a locked rotor condition. In addition, control panel will include LED lights for power and pump run functions. System shall be “Oil-Minder” by Stancor,
7. Electrical

a. Electrical power feeder(s) to elevator controller(s), with main line fused disconnect switch.
b. Separate fused electrical service for car lights, in the machine room, as shown on the elevator Shop Drawing.
c. Fused electrical services, convenience outlets (GFI), and switched light fixtures in elevator pits and machine rooms.
d. Dedicated 115V circuit to the sump pump controller, located in the elevator machine room.
e. Fused electrical service for elevator signal systems.
f. Temporary electrical service for the installation, testing and adjusting of the new elevator equipment.
g. Smoke detectors, as required by Code, at elevator machine room, top and bottom of elevator shaft, and in all elevator lobbies . . . tied into fire alarm system and interlocked with elevator recall system; unless otherwise required by local jurisdiction.
h. Where sprinklered, heat detectors (fixed temperature; below sprinkler temp rating) at elevator machine room and at top and bottom of elevator shaft tied in to fire alarm system and shunt trip of all elevator power including battery lowering feature.
i. Where building is sprinklered, fire alarm connection and programming of flow and tamper switches at sprinkler branch lines serving elevator machine room, top of elevator shaft and bottom of elevator shaft.
j. Open conduit telecommunications system beginning with an open conduit and pulling bushing in the building's main telecommunications room and terminating with a junction box and cover mounted to the elevator controller cabinet.

1.3 DEFINITIONS

A. Hydraulic Elevators: Elevators in which cars are hoisted either directly or indirectly by action of a hydraulic plunger and cylinder (jack); with other components of the Work, including fluid storage tank, pump, piping, valves, car enclosures, hoistway entrances, operation systems, signal equipment, guide rails, electrical wiring, buffers, and devices for operations, safety, security, required performance at rated speed and capacity, and for a complete elevator installation.

B. Defective: Operation or control system failures; performance below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; or other similar unusual, unexpected, or unsatisfactory condition(s) shall constitute defective elevator work.
1.4 SHOP DRAWINGS AND SAMPLES

A. Submit Shop Drawings and Samples as requested by the Owner, of all materials specified herein and in accordance with requirements of the General Conditions. Include detailed information regarding rough-in and other preparatory work by other trades related to the elevator installation(s).

B. Submit sample of finished materials and colors to Owner for approval, consisting of various exposed equipment and accessories, such as indicators, push buttons, etc., for selection and/or approval, as may be required.

C. Manufacturer’s written specifications, installation and maintenance requirements for each product or material to be utilized in the elevator installations.

D. Do not order materials or begin fabrications or installation of materials until Owner’s approval has been obtained.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with all State and Local Authorities having jurisdiction and obtain all necessary permits, pay all fees, obtain all required inspections, and carry out all tests required by such Authorities.

1.6 STANDARDS, CODES AND REGULATIONS

A. Furnish all elevator equipment in accordance with most-stringent applicable provisions of the following Codes and/or Authorities, including revisions and changes in effect on date of these specifications:

   a. Seismic Zone: Comply with code requirements for seismic risk zone as required by governing codes and authorities.


3. National Electrical Code, ANSI/NFPA 70, and other applicable codes and standards as described in Chapter 5, Division 16, Sections.

4. Requirements of any other Codes, Ordinances and Laws applicable with the governing jurisdiction.


1.7 TEMPORARY USE OF ELEVATORS

A. Should the General Contractor desire the use of the elevator(s) prior to the Date of Substantial Completion or certification for operation by State authorities, whichever is later, they shall make the necessary arrangements with the Elevator Installing Firm, subject to the approval of the Owner and governing code compliance.
B. The Contractor shall reimburse the Elevator Installing Firm for any labor and materials which are not part of the permanent installation and which are required to provide temporary elevator service including, but not limited to, temporary car enclosures, guards or other protection for elevator machine room and hoistway openings, main line switch with wiring, necessary power, signaling devices, lights in car, testing and obtaining any special permits or certificates, elevator operators, twice-monthly preventative maintenance as described below, together with any other special labor or equipment needed to permit temporary usage. Protective pads required under this Section as part of the elevator installation shall not be used for temporary protection.

C. In addition, the Contractor shall sign the Elevator Installing Firm’s Temporary Acceptance Form before any elevator is placed into operation. Thereby, the Contractor shall agree to pay the cost of twice-monthly maintenance of the elevator equipment, as described below. The Contractor shall also agree that the complete elevator installation will be left in new condition with all damages corrected and parts indicating wear replaced. A copy of this Temporary Acceptance Form shall be delivered to the Owner prior to any temporary use of the elevator by the Contractor.

D. Such temporary use of the elevator shall be solely at the expense and risk of the Contractor. Immediately prior to the Date of Substantial Completion or certification for operation by State authorities, whichever is later, the elevator subcontractor shall inspect, adjust, and test all components and systems of the elevator, replace all damaged or worn components, install new lamps in car lights and in all indicators and controls. Elevator shall be left with a first class finish and in first class operating condition, subject to the approval of the Owner.

E. Contractor’s use of the elevator shall not be deemed to imply acceptance of the elevator installation and shall not initiate required guarantees and maintenance/service, all of which begin on the Date of Substantial Completion or elevator certification for operation by State authorities, whichever is later.

1.8 GUARANTEE

A. The Elevator Manufacturer and Elevator Installing Firm shall jointly provide special guarantees to include maintenance and call back service, signed by the Contractor, Installer and manufacturer, agreeing to replace, repair, and restore defective (see definition above) materials and workmanship of elevator installation during the guarantee period. The guarantee period is twelve (12) months following Date of Substantial Completion and/or safety tests and certification of the elevators by State Inspectors, whichever is later.

B. This guarantee is not intended to supplant maintenance service and shall not be construed to require free service for periodic examination, lubrication, or adjustment due to normal use, beyond that included in the Specification; nor correction without charge, or breakage, maladjustment, or other trouble arising from abuse, misuses, or any other causes beyond the control of the Elevator Manufacturer and Elevator Installing Firm.
1.9 MAINTENANCE

A. The Elevator Installing Firm shall furnish maintenance and call back service for a period of one (1) year following the Date of Substantial Completion or certification for operation by State authorities, whichever is later, at no additional cost to the Owner. Maintenance services shall be performed at least monthly. Call back service shall be performed upon request of the Owner. This shall consist of responding within one hour of notification during the normal working hours of the elevator trade and within two hours outside of regular working hours.

B. Monthly maintenance shall include, but shall not be limited to, inspections, lubrication, cleaning, replacement of worn or defective components, replacement of all seals, packing and reservoir oil, and adjustment of equipment as required for safe and proper elevator performance and operation at rated speed and capacity. Only genuine standard parts produced by the manufacturer of the equipment concerned shall be used for replacement.

C. All work under the maintenance provision shall be performed by trained, competent personnel under the supervision and in the direct employ of the Elevator Manufacturer and/or Elevator Installing Firm.

D. The maintenance service shall be performed solely by the Elevator Manufacturer and/or Elevator Installing Firm and shall not be assigned or transferred to any agent or subcontractor.

E. Defects due to misuse, accidents, or negligence on the part of the Owner will not be considered to be covered under the maintenance guarantee.

1.10 FIRE RESISTANCE

1.11 Comply with NFPA Standard No. 80 for construction and installation of hoistway entrances. Door units shall bear a UL label of approval as a “1½–hour Fire Door.” Where required by NFPA 80, provide separate UL labels of approval on hardware, sills, closers, and other accessory items of hoistway entrances.

1.12 INSTRUCTION OF PERSONNEL

A. Instruct the Owner’s personnel and the Owner’s current elevator service contractor in the proper use, operation, and maintenance of the elevator.

B. Review emergency provisions, including emergency access procedures and emergency telephone use.

C. Train Owner’s personnel and the Owner’s current elevator service contractor in procedures to follow in identifying sources of operational failures or malfunctions.
1.13 ADDITIONAL REQUIREMENTS

A. It is the responsibility of the Elevator Manufacturer and/or Elevator Installing Firm to examine all conditions on the Drawings and in the Specifications and the governing laws and building code, and to assume all costs in connection with this Contract, including cost of any incidental work and equipment which may not be called for on the Drawings and Specifications but which are necessary for construction and proper operation of elevators or required by the governing laws and building codes.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Hydraulic components shall be manufactured by Cemco Elevator Systems, Canton Elevator, Blain Hydraulics, American Crescent, Elevator Equipment Corporation, or Minnesota Elevator.

B. Controllers shall be manufactured by Elevator Equipment Corporation, Motion Control Engineering, Inc., or G.A.L. Manufacturing Corporation.

C. Elevator cab shall be manufactured by Cemco Elevator Systems, American Crescent, or Columbia Elevator Products.

D. Door equipment shall be manufactured by G.A.L. Manufacturing Corporation.

E. Signal Fixtures and Equipment shall be manufactured by PTL Equipment Mfg. Co.

F. Elevator Installing Firm shall be Stanley, Kone, Otis, Pine State, or ThyssenKrupp. Alternate Bidders must receive approval of the Owner at least five (5) days prior to bid date.

1. The Elevator Installing Firm shall have been regularly engaged in the installation of elevators of the type specified herein and shall be able to demonstrate at least three installations of the type specified made by him within fifty (50) miles of the site which have provided satisfactory operation for a period of at least two years prior to the date of receipt of general bids for this project.

2. Also, the Elevator Installing Firm shall be able to demonstrate that they have provided satisfactory maintenance service for elevators of the type specified, that they have maintained a complete elevator maintenance organization comprised of regularly employed, competent, trained elevator mechanics, and that they have maintained an adequate stock of parts for replacement and emergency purposes, all within 50 miles of the site for a period of at least five years prior to the date of receipt of general bids.

2.2 GENERAL PARAMETERS

A. Quantity and Type: oil-hydraulic elevator(s).
B. Capacity: Minimum 4000 lbs, but must meet stretcher dimensions requirements of IBC 2006 or current code.

C. Speed: To be determined by the Project Design Team.

D. Machine: Dry or submersible pump hydraulic.

E. Machine elevator shaft.

F. Car Inside Dimensions: conforming to stretcher dimension requirements of IBC 2006 or current code.

G. Car Platform Dimensions: Must meet stretcher dimensions requirements of IBC 2006 or current code.

H. Car Enclosure: Steel.

I. Entrances: 3"6" minimum width x 7'-0"H; stainless steel, single speed.

J. Hoistway Access: Drop key, all levels.

K. Signals: Illuminated car and hall buttons; alarm bell.

L. Position Indicators: Car, with car direction lanterns, and All Landing Entrances with chimes.

M. Registration Lights: Car and Corridor Pushbuttons.

2.3 DESCRIPTION OF EQUIPMENT

A. Car Top Inspection Station: Yes.

B. Emergency Car Lighting: Yes.

C. Emergency Operation: Fireman’s Service – Phase I and II, with Barrel-Key FE 01.

D. Floor Designations: Enter per UNH Scheme (e.g. B1, B, G, 1, 2, 3, . . .)

E. Independent Service: Key switch by elevator contractor; ASSA 6000 high security cylinder, provided and keyed by Owner.

F. Keyed Lockout:
   1. In-car for Levels: All Attic and mechanical rooms shall include In-Car lock out, cylinder by ASSA 6000, keyed per UNH Hardware Services. Indicate In-Car Lock-out Levels (e.g. None, Level B, etc.);
   2. Key switches by elevator contractor; ASSA 6000 high security cylinder, provided and keyed by Owner.

G. Sills: Extruded Aluminum.
H. Isolation: Yes.

I. Rail Backing: Comply with seismic code requirements.

J. Casing: Yes.

K. Cylinder: Yes, with PVC protection.

L. Plunger: Yes.

M. Wiring Diagrams: Provide with O&M Manuals.

N. Mechanical Drawings and Cuts: Provide with submittals; include with O&M manuals.

O. Documentation: Provide three (3) complete bound sets of O&M Documentation for all materials and products incorporated into the elevator construction. Refer to Chapter 5, Division 1, Section 01100, if applicable, for more information.

P. Special Features:
   1. Disabilities Act (ADA); comply with current guidelines.
   2. Car Door Full Length Detection Device.
   3. Two-Way Communication, one touch auto dial, built-in; EMS brand preferred.
   5. Tank Heater to maintain temperature of oil at minimum of 100 degrees.
   6. Battery backup for controlled descent to lowest level of egress in event of power loss; with relay(s) as needed to allow interruption by shunt trip when initiated by heat detector activation.
   7. Key switches for in-cab light, fan, hold-open features – cylinders by ASSA.
   8. Provide oil minder pump and sensing packaging. Automatic sump pump with oil-sensing cut out to include 115 V UL-listed pump and control system capable of pumping water while containing oil. System shall function automatically and shall provide for and alarm and separate LED lights in the event of (a) the presence of oil in the sump, (b) high liquid sump, or (c) high amps or a locked rotor condition. Control panel will include LED lights for power and pump run functions. System shall be “Oil-Minder: by Stancor, Inc, or approved equal. Controller shall be located in the elevator machine room.

2.4 ELEVATOR MACHINERY

A. Type of Equipment:
   1. The elevator shall be the “plunger electric” type with direct acting plunger, pumping unit, storage tank and magnetic control valves. The pumping machine associated control equipment shall be located in machine rooms.
   2. The pump shall deliver the oil directly to the cylinder at the necessary pressure and in sufficient quantity to lift the fully loaded elevator at the specified speed. The tank shall act as a storage tank only and the oil shall be pumped into the cylinder on the up trip and shall be returned into the tank on the down trip.
B. Elevator Cylinder and Plungers:

1. The elevator cylinder shall be constructed of steel piping of sufficient thickness suitable for working pressure of 400 pounds per square inch. Cylinders of multiple section construction shall be thoroughly and substantially connected by means of external couplings. The bottom of the cylinder shall be closed and the top provided with a self-adjusting packing that does not require external adjustments, so arranged as to prevent leakage. The cylinder shall be prepared and coated with a butyl type adhesive at a uniform minimum thickness of 10 mils, and covered with an overcoat sheath of virgin, high molecular weight polyethylene, free of contamination from foreign substances, to a uniform thickness of minimum 40 mils. The bottom of the cylinder shall be sealed with an end cap. The end cap must be monolithic with the extruded coating, either by continuous extrusion or plastic welding, and holiday tested. The bottom end cap shall be a high molecular weight polyethylene cap, welded to the bottom pipe section, and protected during shipping by a cushioned, metallic oversheath.

2. The plunger shall be constructed of selected steel tubing of proper diameter, machined true and smooth with a fine polished finish. The plunger sections shall be securely joined by means of internal couplings. Stop rings shall be welded to the bottom of the plungers to prevent the plungers from leaving the cylinders. The plungers shall be secured to the car frame by means of a platen plate. The platen plate shall be isolated from the car frame by means of a thick rubber pad.

C. Well for Cylinder:

1. The well for the cylinder shall be sunk into the ground by the Elevator Installing Firm. Excavation work is unclassified, and shall be made through whatever materials encountered, without extra payment. All parties are advised that excavation may require substantial drilling through rocks and boulders. Well shall be cased and sealed to prevent water from entering inner casing and pit.

D. Pumping Unit:

1. The pumping unit shall be of integral design and shall include an electric motor belt driven to a pump, a control valve assembly, a storage tank, a main-line strainer, necessary piping connections and controller, all compactly designed and mounted on a structural steel bedplate as a single self-contained unit. The motor and pump assembly shall be mounted on a rubber isolated inner base with removable drip pan, and the tank and controller shall be supported above on a structural steel frame. Submersible type pumps are acceptable.

2. Pumps: Shall be a positive displacement screw type to give smooth operation and shall be designed and manufactured specifically for elevator service.

3. Motors: Shall be of alternating current, polyphase, squirrel cage induction type and shall be of a design especially adapted to plunger elevator requirements. Motors shall be premium efficiency.

4. Control Valve Assembly: Shall be of compact design suitable for operation under the required pressures. It shall contain a metered bypass valve, a check valve, a relief valve, a manual lowering valve, metered lowering and leveling valves and pilot valves. An isolated seal and coupling device, designed to reduce the transmission of vibrations and noise to the elevator car, shall be provided.
Operation of the manual lowering valve shall permit the car to be lowered at slow speed, in the event the power fails.

5. Storage Tanks: Oil reservoirs shall be constructed of welded steel sheets, and shall be provided with a cover, a protected vent opening, a filtering screen mounted over the suction inlet and a drain connection. An initial supply of oil sufficient for proper operation of the elevator shall be provided. Tanks shall have a capacity equal to the volume of oil required to lift the elevators to the top terminal plus a reserve of not less than ten (10) gallons.

   a. The tank shall be provided with a marked gauge to meter the hydraulic fluid level. The permissible minimum hydraulic fluid shall be clearly indicated.

   b. A data plate shall be affixed to the tank indicating the characteristics of the hydraulic fluid used, installation date, name of installing firm, name of manufacturer, piston diameter, and manufacturer’s designed head pressure.

6. Sound Reducing Enclosure: The lower area of the power unit where the motor and pump are installed shall be enclosed with removable sheet steel panels lined with sound deadening material to reduce airborne noises, not required where submersible units are provided.

7. Muffler: A blow-out muffler, designed to minimize the transmission of fluid pulsation, shall be furnished and installed in the pipeline between the pumping unit and the cylinder head.

8. Sound Isolation Couplings: A minimum of two shall be installed in the oil line between the pump and jack.

9. Rubber Isolation: A rubber isolation mat shall be provided for underneath the reservoir, motor and pump frame.

10. Rupture Valve: A rupture valve shall be installed in the oil line, located in the pit, between the cylinder and control valves.

11. Isolation Valve and Drain: If elevator machine room is not immediately adjacent to the elevator shaft, provide an isolation valve on the oil line in the elevator pit and a normally capped drain valve between the isolation valve and the cylinder.

E. Piping:

1. Piping shall be furnished and installed between the pumping unit and the cylinder head complete with necessary fittings. A gate valve shall be provided in the line to facilitate maintaining and adjusting the elevator.

2. All hydraulic piping related to the elevator machinery shall be installed so that rigid contact between the piping and other building systems is avoided. Piping supports shall include Neoprene Isolators (1/4 inch static deflection) and Neoprene Filler Sleeves shall be used where piping penetrates walls.

3. All in-ground cylinders shall be encased in PVC.

4. Include wrap-around plastic pipe identification, clearly visible within each space piping is located.

F. Controller:

1. The elevator controller shall utilize a non-proprietary microprocessor based logic system that can be easily serviced by any and all recognized service companies with parts easily accessible on the aftermarket and shall comply with ANSI/ASME
17.1 safety code for elevators. The system shall provide comprehensive means to access the computer memory for elevator diagnostic purposes, and shall have permanent indicators to indicate important elevator statuses as an integral part of the controller. Systems that require hookup of external devices for troubleshooting shall have the device provided to the Owner as part of the installation.

2. Failure of any single magnetically operated switch, contactor, or relay to release in the intended manner or the occurrence of a single accidental ground or short circuit shall not permit the car to start or run if any hoistway door or gate interlock is unlocked or if any hoistway door or car door or gate contact is not in the made position. Furthermore, while on cartop inspection or hoistway access operation, failure of any single magnetically operated switch, contactor or relay to release in the intended manner or the occurrence of a single accidental ground shall not permit the car to move even with the hoistway door locks and the car door contacts in the closed or made position.

3. 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 out of service timer has elapsed or when the motor limit timer or valve limit timer has elapsed. In addition, provide means of displaying other special or error conditions that are protected by the microprocessor.

4. All available options or parameters shall be field programmable, without need for knowledge of any programming languages. Programmable options and parameters shall be stored in a nonvolatile memory. As a minimum, there shall be a 32 character alphanumeric display to be used for programming and diagnostics. Programmable parameters and options shall include and not be limited to the following:

   a. Number of stops/opening served (each car).
   c. Fire Floors (Main, Alternates).
   e. Floor Encoding (Absolute PI).
   f. Digital PI’s/single wire PI’s.
   g. Programmable door times.
   h. Programmable Motor Limit Timer.
   i. External Car Shutdown Input (e.g. Rescuvator).
   j. External Low Oil Sensor Input.
   k. External Viscosity Control Input.
   l. Parking Floors.

5. Each elevator shall have its own computer and dispatching algorithm. Should one of the computers lose power or become inoperative in any way, the other computer shall be capable of accepting and answering hall calls. When both computers are in operation, only one of them shall assume the role of dispatching the hall calls to both elevators. Communication between the controller computers shall be accomplished through a high speed serial link using a single twisted shielded pair of wires.

6. On power up the controllers shall move the car to the closest floor to identify the position of the elevator.
7. The controllers shall have a real-time clock/calendar with battery backup.
8. The controllers shall have a serial port for communication with any data or computer terminal such as CRT terminal, modem, etc.
9. Overload relays shall be of the manual reset type of suitable size for the motor furnished.
10. A main line switch shall be provided on the controllers to avoid the possibility of pump churning.

G. Solid State Starting: To reduce starting currents, Solid State reduced voltage shall be provided for the pump motors to limit starting current to 300% of full load running current. For motor horsepower 50 and greater, solid state starter will be required.

H. Stop Switch in Pit: A stop switch shall be provided in the elevator pit(s) and shall conform with the specified code. The pit stop switch, when in the off or “stop” position, shall eliminate, along with other operations, car leveling.

I. Car Stall Protective Circuit: In the event the car should stall while ascending as the result of a relay or control failure, valve failure, low oil in the system, etc., a special circuit shall be provided which shall automatically return the car to the bottom landing and perform a normal door operation, after which the elevator shall be completely shut down except for the door operation. Service will be restored by recycling the main line disconnect switch.

J. Motor Limit Timer: A motor limit timer function shall be provided which, in the event of the pump motor being energized longer than a predetermined time, shall cause the car to descent to the lowest landing, open the doors automatically and then reclose them. The car calls shall then be canceled and the car taken out of service automatically. Operation may be restored by cycling of the power disconnect switch.

K. Valve Limit Timer: A valve limit timer shall be provided which shall automatically cut off current to the valve solenoids if they have been energized longer than a predetermined time. The car calls shall then be canceled and the car taken out of service automatically. Operation may be restored by the cycling of the power disconnect switch.

L. Wiring: The Elevator Installing Firm shall furnish and install complete, all necessary insulated wiring to connect all parts of the equipment. All wire and traveling cables shall have a flame retarding and moisture resisting outer covering and shall be run in metal conduit, metallic tubing, wire ducts or raceways. Traveling cables shall be flexible and suitably suspended so that there is no strain on individual conductors. All electrical material and work shall, at minimum, comply with the latest enforcing electrical codes. All electrical penetrations through fire-rated walls shall utilize non-combustible sleeves and be appropriately sealed.

M. Guide Rails:

1. Guide rails shall be planed steel, securely fastened to the building structure with steel brackets by means of bolts and forged steel rail clips. Rails shall conform in all respects with the elevator codes, and shall be located so that the entire car assembly shall be in true balance with the guide rails.
2. Guide rails shall be supported by brackets at each floor. Where fastenings are over 12 feet apart, rails shall be reinforced with 9-inch channel backing, or approved equal, to ensure the rigidity required for elevator capacity, platform size and method of loading.

3. All joints shall be located so as not to interfere with supporting rail clips and brackets. Shims used to secure rail alignment shall be designed so that they remain in position, even though the fastening bolts may be loosened.

4. Guide rails shall extend to within three inches of the underside of the hoistway ceiling with a maximum deviation 1/8-inch from plumb in all directions. Provide a minimum of ¾-inch clearance between bottom of rails and top of pit channels.

5. Guide rail anchorages in pit shall not be made in a manner that will reduce the effectiveness of the pit waterproofing, if applied.

6. Guide rails shall be free of any signs of rust or abrasion, and shall be filed to remove all rough edges prior to final inspection. All guide rail joints shall be filed to assure perfectly matching surfaces.

7. For attaching of guide rails in concrete or brick, where steel framing is not available, install approved inserts. Installation by Contractor.

8. Rail brackets and fishplates shall be installed in accordance with applicable seismic requirements.

N. Roller Guides: Roller guides shall be mounted on the top and bottom of the car frame and shall be held in contact with the guide rails. Each roller shall be adjustable and set to provide equal pressure on all rollers.

O. Buffers: Adequate spring buffers shall be provided on the pit channels. Buffers shall be blocked up as required to protect the cylinder head and packing gland in the event the car should pass the bottom final limit switch setting. Strike plates shall be mounted on the underside of the car frame. Each spring buffer shall be provided with a marking plate showing its load rating and stroke, and the number of springs. Where the springs are removable, each spring shall be identified and the assembly marking plates shall indicate this identification. Markings shall be made in a permanent and legible manner.

2.5 OPERATION AND CONTROL

A. Collective Automatic Push Button Operation:

1. Control of the elevator(s) shall be automatic in operation by means of push buttons in the elevator car(s) marked for each of the landing levels served and button boxes located immediately adjacent to the elevator door frame at each landing, wherein all stops registered by the momentary pressing of landing or car buttons shall be maintained until the car answers the call. Each landing station shall contain push buttons that “light up” when pressed to indicate that a call has been registered, which will bring the car to that particular landing (see Car and Hall Stations). A time delay, non-interference feature shall be incorporated in the control mechanism to allow ample time for opening and closing of the car and hoistway doors before it is again placed in motion.

2. The car operating panel(s) shall contain a key operated stop switch to interrupt the power supply to the valves and pump motor, independently of the regular operating devices. The opening of the stop switch shall not cancel the registered calls or the leveling operation while the elevator is in the landing zone and, after
the stop switch is closed the car shall continue to answer its various calls. The
car panel(s) shall also contain key operated light, fan, and door hold switches.

3. Hall or car call registration and lamp acknowledgment shall be by means of a
single wire per call besides the power busses. Systems that register the call with
one wire and light the call acknowledgment lamp with a separate wire are not
acceptable.

4. Elevator Car and Hall Stations:

a. All the signal systems described herein will be manufactured by PTL
   Equipment Company, Inc.
b. All faceplates shall be flush mounted stainless steel with #4 satin finish and
   shall be .135 thick.
c. All engraved numbers and letters on the faceplate for floor buttons shall be
   5/8" high.
d. All other buttons and switches shall be identified with engraved lettering
   approximately 5/16" high.
e. All symbols shall company with ANSI Handicap Code A117.1, latest
   edition, Rule 210.B.
f. Buttons shall be of the mushroom type bottoming out on the plate. Buttons
   shall be stainless steel with a maximum protrusion from the cover surface
   of 3/16".
g. All floor buttons and switch assemblies requiring visual acknowledging light
   shall be ¼“ diameter clear Lexan Jewel replaceable insert type.
h. Hall push buttons shall have direction arrows and Lexan inserts.
i. Contact switch assembly shall be the Square D Class 9001 Type K
   contact.
j. At keyed stop, light, fan, and door hold key switches, provide and install
   ASSA 6000 MORTISE ELECTRIC SWITCH LOCKS with removable cores.
k. Provide one (1) control key and three (3) change keys for construction
   phase of project. Control key and change keys to be turned over to UNH
   Hardware Services at completion of project.
l. At Independent Operation and any required floor lock-out key switches,
   provide and install necessary key switches and install ASSA Series 6000
   high security cylinders, which shall be provided and keyed by the Owner.
m. Hall stations must be provided with an appropriately sized box for the shaft
   construction to ensure that the faceplate can be installed tight to the
   finished wall surface.

5. Operating Procedures:

a. The operation of the elevator(s) shall be from a single riser of pushbutton
   boxes at each landing, with “UP” and “DOWN” pushbuttons at all
   intermediate landings, and a single pushbutton at each terminal landing.
b. If the hoistway door interlock and the car door contact circuits have been
   activated, the car shall start automatically upon activation of one or more
   pushbuttons within the car or at a landing. The car shall stop at any
   landing reached for which a car call or a hall call in the direction of travel
   has been registered. The car shall not respond to hall calls registered in
   the opposite direction of travel unless it is the last call reached in the
   direction ahead of the car. The car shall make stops in the natural order in
   which calls are reached, irrespective of the sequence of which the calls
6. Firefighters Service: The elevator(s) shall be equipped with Phase I, Emergency Recall Operation and Phase II, Emergency In-Car Operation. The Firefighters Service shall comply with Fireman's Service-Phase I and II, with Barrel-Key FE 0.

   a. Designated level shall be determined by the Durham Fire Department and NH State Fire Marshal's Office.
   b. Alternate designated level shall be determined by the Durham Fire Department and NH State Fire Marshal's Office.

7. Dispatching Procedures (Applicable to Duplex Operation Only):

   a. One car shall be parked at a predetermined main lobby landing and the other car shall remain at the last landing served or, optionally, be moved to a predetermined landing. Both cars shall, if idle, have their doors closed. The car at the main landing shall be considered the "parked" car and the other shall be considered the "free" car. Should both cars complete their calls at the main landing, the car which arrives first shall be considered the "parked" car. An idle "free" car shall respond to any landing call registered either above or below the floor at which it is located. When the "free" car is responding to car and/or landing calls, the "parked" car shall automatically respond to any up call or down call registered below an up-traveling "free" car, or to any up call or down call registered above a down-traveling "free" car. In addition, continuous hall call demand for longer than a programmable time shall also release the "parked" car. If the "parked" car leaves the main landing for any reason, it shall become and assume the duties of a "free" car, and the first idle "free" car shall proceed to the main landing to become the "parked" car.

8. Independent Service: The elevator car operating panel(s) shall be provided with a key switch to remove them from the "Automatic" operation where the elevator(s) shall operate in response to car calls only "in an independent mode of operation". Independent operation key switch shall be provided by the elevator installer. ASSA 6000 high security cylinder shall be provided and keyed by Owner for installation by the elevator installer.

9. Lock-Outs: If specified, the elevator car operating panel(s) and/or hall stations shall be provided with a momentary contact key switch(es) to control access to a particular landing level(s) and/or ability to call the car. The key switch(es) are to be wired in series with their respective call button such that turning the key in the key switch allows the particular call button on the car operating panel or hall station to register. Otherwise under normal conditions, the key-controlled call button(s) shall not be allowed to register. Attic and mechanical rooms with elevator access shall all have lock-outs.

B. Signals:

1. Car and Hall Buttons: When a call is registered by pressing a button, it shall illuminate to indicate that a call has been registered. The button shall remain lit until the elevator answers the call.
2. Alarm Bell: An alarm bell shall be provided in the hoistway, connected to the alarm bell button in the car.
3. Make all provisions to comply with State and Federal Disability Acts and codes referred to herein.

C. Two-Way Leveling: The car shall be equipped with a two-way leveling to automatically bring the car sill level with the landing sill, with a minimum one-quarter (1/4) inch tolerance above or below the floor, regardless of load. The two-way leveling system feature shall be automatic and independent of the operating device.

D. Automatic Terminal Stops: Normal and Final Switches shall be provided at the terminal floors to bring the car to a stop independent of their regular operating device.

2.6 CARS

A. Car Frames:

1. Car frames shall conform to the requirements of the Code and shall be constructed of steel plates and structural shapes securely riveted, bolted, or welded together. No cast iron shall be permitted. The entire assembly shall be of rugged construction, and amply braced to withstand unequal loading. Car frame members shall be such as to relieve the car enclosure of all strains. Car frames shall be balanced front to back and side to side. Provide weights and frames to achieve the required true balance. Weights and frames used for balancing shall be properly located.

2. Bolts which pass through the flanges of structural beams or channels shall be furnished with beveled washers at all points of contact with slope of the flange.

B. Car Platform: The car platform shall consist of steel frame, steel stringers, and a substantial wood floor, or shall be constructed entirely of suitable reinforced steel. Car thresholds shall be of extruded aluminum, with the necessary grooves for the car doors. The underside of the wooden platforms shall be covered with sheet steel not less than 27 gauge thickness. The platforms and car sills shall be arranged to accept finish flooring.

C. Car Enclosures: The car enclosure shall be constructed of the following construction and design. The car enclosures shall be UL certified, in compliance with A17.1 Section 204.

1. Provide car enclosures of the materials and finishes as hereafter indicated.

2. The car canopies shall be of best-grade cold-rolled furniture steel not less than No.14 US Standard Gauge. The canopies shall be of one-piece construction and reinforced to form a working platform to withstand a minimum weight of two workmen.

3. The entrance columns shall be square. A fascia shall be provided above the return panels from top of car entrance to ceiling. Entrance columns, return panels and fascia shall be stainless steel, not less than 14 gauge, with a No.4 satin finish.

4. Finish flooring shall be selected by the Architect.
5. The walls of the cab shall be constructed of 16 US Gauge commercial quality cold rolled steel adequately reinforced. Panels shall be formed to provide light-proof joints and securely fastened to the platform with bolts, a minimum 1’0” on center.

6. The finish panels shall be constructed of wood core, fire retardant, faced and edged on four sides with plastic laminate. Panels shall be removable.

7. The cabs shall be provided with emergency exit covers located in the canopy. The emergency exit covers shall be kept in the closed position when not in use by a manually operated self-locking latch or bolt without the use of keys or tools. The locking devices shall be accessible only from the car top. The covers shall be hinged and equipped with a handle, mounted on the top of the cover.

8. Necessary cutouts shall be provided in the car for operating fixtures, signal fixtures, etc., as specified elsewhere.

9. Ventilation shall consist of a two-speed fan exhaust fan located in the car ceiling.

10. The Elevator Installing Firm shall furnish and install a suitable communications cabinet in the car and shall furnish and install the necessary communication wires from the cabinet to a junction box, furnished and installed by the electrician, on the machine room controller. The communication system shall be of the vandal-resistant, hands-free phone equipped with push button automatic dial system.

11. Lighting shall be from two fluorescent light fixtures mounted on the car ceiling and projected through a suspended ceiling. Light fixtures shall use 48” T5 fluorescent lamps; ballasts shall be energy-efficient electronic program type, one per fixture. Lamps shall be 3500 Kelvin with a CRI of 80 or greater.

12. The suspended ceiling shall consist of framing members of extruded aluminum with finish of baked enamel. Framing members shall be so designed to prevent panels from becoming dislodged during normal operation and to allow easy removal of panels for the cleaning and replacement of lighting fixtures and lamps. Removable panels shall be smooth acrylic, frosted.

13. Provide an emergency light mounted above the car operating panels as required by code.

14. Provide stainless steel handrail(s) for each elevator. The handrail shall be located on three walls.

15. Stainless steel pad buttons and removable protective pads shall be provided for the elevator cabs.

16. All interior and exterior steel surfaces shall be bonderized or given an approved rust preventative process before the finish is applied.

17. Finish: All furniture steel work on cars shall be thoroughly cleaned, followed by a baked-on primer coat and sprayed-on two-coat baked enamel finish. All exposed surfaces of the furniture steel work shall receive applications of mineral filler with each coat application and shall be baked, sanded, and rubbed smooth between coats. Colors of all painted finishes shall be custom color as selected by the Owner.

18. Particular care must be taken in boxing and crating cabs to avoid damage in transit, as cabs and accessories must be in perfect condition at the time of final inspection after installation.

2.7 DOORS AND ENTRANCES

A. Car doors shall be as follows:
1. Minimum 3’6” Wide x 7'-0”H; Single speed.
2. The car doors shall be horizontal sliding type construction not less than one (1) inch thick. The car door leaves shall be hung on two-point suspension sheave-type hangers similar to those specified for hoistway doors. Doors shall be especially design and reinforced for power operation. Face doors with stainless steel.

B. Hollow Steel Elevator Hoistway Entrances:

1. Furnish and install entrance units with frames, sill struts, hanger supports and cover, fascia, dust covers and toe guards as described below.
2. Frames: The frames shall be made from No.14 US Gauge satin stainless steel and shall comprise head and jamb sections with integral casing of trim and bolted to form one-piece unit frames. Frames shall contain suitable materials for effective sound deadening and bear UL Labels. All frames shall be securely fastened to sills and hanger supports and shall be returned on the hoistway side to present a neat appearance.
3. Doors: Door panels shall bear UL Labels, and be flush and formed from not lighter than No.16 US Gauge satin stainless steel and all materials for sound deadening. Bottom of doors shall be provided with removable laminated guides which run in the sill slots with minimum clearance. All doors to be reinforced and provided with keyways as required for door operating mechanisms and to meet the special codes. Doors shall be reinforced for separate hangers or built to include integral hangers. Provide a “Drop Key” access on all landing doors.
4. Sills: The sills shall be of extruded aluminum. Finish with non-skid surface. Grooves for the door guides shall be machined with minimum clearance. The sills shall be supported on steel anchors securely fastened to the floor construction. The underside of the landing sills shall be thoroughly grouted by the General Contractor the full width of the door opening.
5. Fascia Plates and Toe Guards: Fascias and toe guards shall be No.14 US Gauge steel. Toe guards shall be installed on the lowest landing sill extending down below the travel of the elevator and on the top landing header gradually beveled toward and fastened to the hoistway wall. Fascia plates shall extend from the headers to the underside of the landing sills at each floor. The fascia plates shall be reinforced as to prevent against deflections and secured to prevent contact with the elevator and/or the elevator equipment.
6. Hanger Supports and Cover Plates: Hanger supports shall be 3/16 inch thick formed sections securely bolted to the struts. Cover plates shall be made of No.14 US Gauge steel extending the full travel of the doors and shall be made in removable sections for the purpose of servicing the hangers and other equipment from within the elevator car.
7. Struts and Closer Angles: Structural steel angles shall be furnished of sufficient size to accommodate the door closures. Angles shall be continuous and securely bolted to the sills and building beams above. Strut angles shall be provided with rubber stops. The stops shall be adjusted to allow the landing doors to fully open but prevent the hanger roller from leaving the tracks.
8. Sight Guards: Sight guards shall be furnished, finished to match the landing doors.

C. Door Operators:
1. Doors on the car and at each hoistway landing shall be operated quietly and smoothly by an electric operator, which shall open and close the car doors and hoistway doors simultaneously.

2. The car doors shall be provided with a non-contact detector system, which shall cause the doors to reopen upon the detection of a person or object in the entrance of the elevator. The detector shall extend the full length of and not project beyond the leading edge of the car doors. The car door protection device shall be of the infrared type ray screen. The infrared ray screen, when interrupted, shall reverse any active door closing operation and/or hold the doors in the open position, permitting the doors to reclose a programmable period of time after the interruption has ceased. Pressing of car operating floor button, or “Door Close” button, shall cancel the door timing interval and cause the doors to close provided the infrared ray screen is not interrupted. Door nudging is not acceptable.

3. A door restrictor shall be installed on the car doors to prevent the opening of the car doors from within the elevator unless the elevator is in the landing zone.

4. Each hoistway door shall be equipped with a positive electromechanical interlock and auxiliary door closing device so that the elevator can be operated only after the interlock circuit is established. The interlock operations shall comply with the specified codes.

5. An electric contact for the car door shall be provided which shall prevent the elevator movement away from the landing unless the odor is in the closed position as defined in the specified codes.

6. The door shall open automatically only after the elevator comes to a complete level stop, and close automatically either after the expiration of a time interval or the moment a car button call is registered. Only the door shall open for the landing being served. A “Door Open” button, in the car station, shall cause the doors to stop and reopen upon activation of that button. The activation of a landing or car station button, at the landing where the elevator is located shall cause the doors to stop and reopen.

7. Door protection timers shall be provided for both the open and close directions which will help protect the door motor and which will help prevent the car from getting stuck at a landing. The door open protection timer shall cease attempting to open the door after a predetermined time in the event that the doors are prevented from reaching the open position. The door close protection timer will reopen the doors for a short time in the event that the door closing attempt fails to make up the door locks after a predetermined time.

8. A minimum of three different door standing open times shall be provided. A car call time value shall predominate when a car call only is canceled. A hall call time value shall predominate whenever a hall call is canceled. In the event of a door reopen from the safety edge, photo eye, or door open button, a separate short door time value shall predominate. The timing value for these timers must be field adjustable.

D. Door Hangers and Tracks: Furnish and install, for each hoistway sliding door sheave type, two point suspension hangers and tracks complete. Hanger brackets shall be integral with the door or applied. Sheaves and rollers shall be of steel and shall include ball bearings properly sealed to retain grease lubrication. Hangers shall be equipped with adjustable ball bearing rollers to take the upthrust of the doors. Tracks shall be
drawn steel shapes, smooth surface, and arranged to hold lubrication. Suitable means shall be used to transmit motion from one door panel to the other.

E. Finish of Doors and Frames:

1. All exposed parts of hoistway doors and frames shall be satin finish stainless steel.
2. Structural members shall receive a shop coat of dark paint.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect hoistway, hoistway openings, pit, and elevator equipment room. Verify all critical dimensions, and examine supporting structure and the conditions under which the work is to be performed. Report, in writing to the Contractor with copies to the Owner and Architect, any conditions that might adversely affect the installation or ultimate operation of the elevator. Do not proceed with elevator installation until unsatisfactory conditions have been corrected.

B. The Elevator Installing Firm shall be responsible for making field measurements of the machine rooms, hoistway, and openings for entrances before submitting drawings. After approval of shop drawings, the Elevator Installing Firm shall be responsible for the installation of equipment without field changes.

C. Installation of elevator plant shall be complete in all respects and in a first-class manner, in accordance with the approved shop drawings, and the requirements of the laws, rules, regulations, codes, and industry standards specified herein.

D. Elevator work shall be complete in all respects, with all components properly adjusted, and with all operating mechanisms and controls in proper working order.

E. Comply with manufacturer’s instructions and recommendations for all installation work.

F. Provide welded connections for installation of elevator work unless bolted connections are required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welders.

G. Coordinate elevator work with work of other trades. Properly time and sequence the work to avoid construction delays.

H. Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure-borne noise from the elevator system(s).

I. Lubricate operating parts of systems as recommended by the respective manufacturer.
J. Coordinate installation of hoistway entrances with car entrances. Where possible, delay final adjustment of sills and doors until car is operable. Reduce clearances to minimum, safe, workable dimension at each landing.

K. Set sills accurately aligned with finished floor at all landings.

3.2 EXCAVATION

A. A hole shall be excavated by the Elevator Installing Firm to accommodate the plunger and cylinder, and the bid shall be based on the possibility of encountering rocks, boulders, sand and water. If such obstructions are encountered, no additional compensation will be provided.

B. All bidders shall visit the building/site prior to bidding, to examine existing conditions.

3.3 WIRING

A. Furnish and install as work of this Section all wiring necessary to connect operating buttons, switches and signals in the hoistway and all electrical equipment on the car to the elevator control panel. The wiring shall be installed in a neat and orderly manner, and shall be installed in conduit, electrical metallic tubing or metal wireways, excluding traveling cables, except that “liquid-tight” flexible conduit may be used for short runs.

B. Traveling cables shall be of the best grade for service and shall be so installed to provide a proper size loop to the car. The traveling cables shall have a fire resistant outer braid. Protection against wear shall be provided on any structural surface where the traveling cables come in contact during the movement of the elevator.

C. Three complete sets of wiring diagrams containing any field corrections, if necessary, shall be provided to the Owner as part of a complete Operations and Maintenance manual submission upon completion of the installation of elevator equipment.

3.4 FIELD QUALITY CONTROL

A. Upon nominal completion of elevator installation, and before permitting use of the elevator (either temporary or permanent), perform formal acceptance tests as required and recommended by governing codes and authorities.

B. Notify Contractor, Owner, and Architect of any scheduled formal inspection of the elevator installation. Provide 48-hour minimum advance notification.

3.5 PROTECTION

A. The Contractor shall be responsible for protection of the elevator installation after installation. Protection shall include suitable coverings, barriers, devices, signs, or other methods or procedures to protect elevator work from damage or deterioration. Protective measures shall be maintained throughout the remainder of the construction period. For items that cannot be refinished in the field, return them to the shop for
repair and complete refinishing or replace with new. All work shall be left clean and free of blemishes upon the Date of Substantial Completion.

B. See requirements in Part 1 of this Section regarding temporary use of the elevator.

END OF SECTION 14240
SECTION 15000 – GENERAL MECHANICAL REQUIREMENTS

1.1 ENERGY EFFICIENCY

A. Design firms shall provide the University with computer-generated energy models for the building using the appropriate modeling software to analyze various premium energy efficiency measures. Energy savings should drive the LEED process. Energy Modeling results shall meet or exceed the current NH Energy Code Requirements http://www.puc.nh.gov/EnergyCodes/energypg.htm.

B. Electric heat shall not be allowed for any space, unless approved in writing by the University.

C. Air-conditioners, heat exchangers and other equipment with water-cooled once-through flow systems are not acceptable.

D. Demand control ventilation utilizing carbon dioxide sensors shall be provided on all air handling systems serving auditoriums, lecture halls, and large classrooms to provide proper outside air ventilation and indoor air quality with maximum energy efficiency.

E. Variable frequency drives shall be used on all fan and pump motors (both constant volume and variable volume applications).

F. Energy recovery shall be used on all air handling systems. Air-to-air energy wheels that recover both sensible and latent heat are preferred.

G. In residential/dorm buildings and office spaces, window switches should be used that shut down zone equipment (e.g., fan coils) when the window is opened.

H. Energy efficient equipment as determined by the latest edition of the following industry standards shall be used (most stringent requirements shall apply):

   1. ASHRAE Standard 90.1

I. All motors shall be premium efficiency as determined by the latest edition of the following industry standards (most stringent requirements shall apply):

   1. ASHRAE Standard 90.1

1.2 REFRIGERANTS

A. All University departments purchasing and/or installing refrigeration and/or air-conditioning units shall notify Facility Operations and Maintenance of said purchase so that equipment records and inventory can be kept current and shall submit all
specification sheets, maintenance manuals and any other pertinent data pertaining to said equipment.

B. The purchase or installation of refrigeration and/or air-conditioning systems utilizing chlorofluorocarbons (CFCs) is not acceptable. LEED EA prerequisite 3 Refrigeration Management requires zero use of CFC-based refrigerant in new base building HVAC systems. When reusing existing base building HVAC equipment, a comprehensive CFC phase-out conversion must be provided.

C. All new refrigeration/air-conditioning equipment shall utilize refrigerants that do not contain HCFCs or CFCs. LEED EA credit 4 Enhanced Refrigerant Management requires that refrigerants used minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming AND do not install fire suppression systems that contain ozone-depleting substances (CFCs, HCFCs or Halons). In order to minimize the number of refrigerants in inventory, the following refrigerant types shall be used unless approved in writing by the University:

1. R134a – medium temperature applications. Packaged refrigeration and air conditioning equipment.
2. R404a – medium and low temperature applications. Reach-in and walk-in coolers and freezers, environmental rooms.

D. All contractors installing, servicing or repairing heating, air-conditioning and/or refrigeration equipment must certify to the University owner that their company and service/installation personnel are in compliance with all requirements of Section 608 of the Clean Air Act of 1990, and any and all subsequent amendments.

E. All obsolete HVAC & refrigeration equipment shall be removed and discarded properly, not abandoned in place. Evacuation reports shall be submitted to the University Project Manager to document the reclamation of all refrigerants.

F. The University, specifically Facility Operations and Maintenance, reserves the option of recovering refrigerants from all equipment being removed by outside contractors due to replacements, repairs and/or renovations.

1.3 GENERAL GUIDELINES

A. All electric actuators provided as part of a UL rated smoke damper or combination fire/smoke damper shall be Schneider Electric DuraDrive, no exceptions. Designer shall clearly specify this requirement to ensure that all dampers whether provided by the Mechanical Contractor, BAS Contractor or by the equipment manufacturer are provided with Schneider Electric DuraDrive electric actuators.

B. Submetering is required for local/remote monitoring of large energy consuming equipment, and areas in residence halls and dining halls that will be separately billed by UNH Energy and Utilities.

1. Sub metering is required for local monitoring of large energy consuming equipment (e.g. chiller plants), make-up water supply to cooling towers or when
2. Metering and sub metering plans shall be submitted for review and approval with Design Development Documents.

C. In addition to performance characteristics, specific product manufacturers listed in the standards are designed to control the University's maintenance and operations costs by minimizing spare parts stocks and personnel training requirements.

D. All Serviceable equipment (smoke dampers, fire dampers, control dampers, actuators, duct smokes, fans, valves, coils terminal units, pumps, filters, isolation valves, clean-outs, junctions, etc.) installed behind an inaccessible finished surface shall require the installation of suitable access doors or reasonable size to accommodate inspection, maintenance and repair. Access doors may not be blocked by conduit, ductwork or any other obstruction.

E. All new equipment shall be cleaned and vacuumed prior to start up. All ductwork and piping shall come to the site capped. Ductwork and piping shall remain capped or sealed throughout construction.

F. Final approval in writing is required from the University to the contractor prior to mechanical equipment starting up for temporary purposes.

G. During air handler startup all supply and return registers and diffusers shall be protected with 1” minimum roll filter.

H. Equipment Identification: Proper tagging shall be included of all equipment and valves. Phenolic tags shall be installed in the field and attached to the ceiling grid identifying valves and equipment location above the ceilings. Valve charts are required for all installations including plumbing and HVAC systems installed.

I. Pipe Identification: All pipes in mechanical rooms and above ceilings shall be identified with the applicable colors with appropriate self-sticking or strap-on identification and arrows indicating direction of flow.

1. Color Identification system by piping system.

J. Lined Ductwork is not permitted.

K. At the time Design Development documents are delivered to UNH, the project architect and or mechanical and electrical engineers shall provide signed written certification that the design meets all requirements of the New Hampshire State Energy Code in accordance with the New Hampshire Stand Building Code. The University may require more stringent specific energy efficiency measure.

L. The University requires that for new spaces created by portioning of existing rooms/buildings or by additions shall meet the following minimum standards:

1. Ventilation – to provide a healthy working environment, all occupied spaces shall be ventilated to meet current ASHRAE, ICC, International Mechanical and
1.4 METERING

A. Gas and water meters shall be provided with dry contact pulse outputs and a local register readout. Meters with pulsing units that generate a voltage impulse are not acceptable. Pulse rates shall be no faster than 1 pulse per second. The BAS contractor shall run a pair of wires from each gas or water meter pulser to a 6x6x4 non-metallic weatherproof junction box located on the building exterior wall next to the gas meter for University installation of a meter reading radio transmitter.

B. Meters shall also have standard numerical register for local reading. Water meters shall read in gallons and gas meters shall read in cubic feet. The contractor providing the meter is responsible for factory startup and calibration of the meter and coordination to ensure that meter pulse output meets requirements of University radio meter reading system. Radio meter reading specifications shall be included in the plumbing and gas specifications as required.
SECTION 15180 – DISTRICT HEATING AND COOLING PLANT UTILITIES

1.1 SUMMARY

A. The purpose of this standard is to provide design guidelines and requirements for projects which require connection to one of the district heating and/or cooling plant utility systems.

B. The University currently has 2 district plant systems:

1. Campus District Hot Water System.
2. Campus District Steam and Condensate System.
3. Philbrook Hall Central Chilled Water Plant: This plant generates 42 degree chilled water for cooling existing and new buildings.

C. Refer to the current University Utility Master Plan for additional information.

1.2 DISTRICT HOT WATER GUIDELINES

A. District heating connections and related BAS controls for space heating are indicated in Attachment A.

1.3 UNDERGROUND HOT WATER SYSTEM PRE-INSULATED PIPING

A. Under development.

1.4 DISTRICT STEAM AND CONDENSATE GUIDELINES

A. Under development.

1.5 UNDERGROUND STEAM AND CONDENSATE PRE-INSULATED PIPING

A. Under development.

1.6 DISTRICT CHILLED WATER GUIDELINES

A. The designer shall coordinate with the University’s Facilities Design and Construction staff on the capacity of each building’s chilled water system. Possible future cooling capacity shall be included in the project as determined by the University.

B. The design shall determine winter cooling capacity needed for the building. Some buildings will need a reduced chilled water flow rate capacity for cooling during the winter. This reduced capacity may be best distributed by smaller alternate distribution pumps rather than by reducing the speed of the main larger distribution pumps.
C. Individual building chilled water systems shall be separated from the central plant chilled water loop with the utilization of a plate and frame heat exchanger located in one of the building’s mechanical rooms.

D. The project design shall include the following:

1. Connection to the buried distribution lines of the central chilled water system with pre-insulated piping.
2. Providing utility meter. All meters to be provided by contractors.
3. Providing a heat exchanger to separate the building chilled water system from the central plant loop.
4. Providing a building side chilled water distribution system or connecting to an existing chilled water system.
5. Refer to attached schematic for utility chilled water piping connection layout requirements.

E. Reuse of Existing Equipment

1. Hydronic equipment for existing chilled water systems shall be reused as much as possible when the equipment is in good working order and is of the capacity required by the new chilled water system.
2. If the equipment is within three years of the expected service life, the University shall decide if the existing equipment shall be replaced.
3. All obsolete chilled water components shall be identified, removed, and disposed of in accordance with University requirements identified in this standard.

F. In general, the building side chilled water distribution system shall have variable speed pumps, two way control valves at the cooling coils, and speed control via differential pressure. Existing chilled water building side distribution systems may be upgraded to include these energy saving features.

1.7 UNDERGROUND CHILLED WATER SYSTEM PRE-INSULATED PIPING

A. Provide pre-insulated piping by Rovanco Piping Systems, Inc. for underground chilled water supply and return service complete with high-density polyethylene (HDPE) outer casing, polyurethane foam insulation, and steel carrier pipe. Carrier pipes shall be prefabricated and pre-insulated in single or double-r.

B. Five percent of the welds for buried pre-insulated piping system shall be inspected by x-ray.

C. Provide steel carrier pipe with field-welded joints. Carrier pipe shall be Schedule 40, ASTM A53, Grade B, ERW for sizes 2” through 10” and Standard Weight, ASTM A53, Grade B, ERW for sizes 12” and larger.

D. Provide factory foamed-in-place polyurethane foam insulation with the following minimum characteristics:

1. K-factor: 0.130 Btu-in/hr-ft2-0F
2. Density: 2.0 pounds per cubic foot
3. ITT Closed Cell Content: 90-95% in conformance with MIL-I-24172 & ASTM C 591 Insulation shall completely fill the annular space between the carrier pipe and outer jacket.

E. Provide outer jackets of seamless extruded black high-density polyethylene (HDPE). The polyethylene shall be manufactured from polyethylene resin compound qualified as Type III, Category 5, Class C, Grade P23 or P34 in accordance with ASTM D1248 and D3350. PVC or FRP jackets shall not be acceptable. HDPE jackets having less than the specified dimensional requirements shall not be acceptable.

F. Provide with each length of pre-insulated pipe and exposed ends of fittings watertight mastic end seal at jacket and pipe surfaces. All exposed field cuts will be sealed with a field applied mastic end seal with materials supplied by the manufacturer.

G. Provide field-applied heat shrinkable end caps, for terminal ends of system, designed to prevent the intrusion of ground water into the insulation medium.

H. Provide joint insulation and closure materials as factory supplied assemblies consisting of two-part field-applied urethane foam insulation, HDPE sleeves, and heat-shrinkable wrap-around sleeve closures. The installing contractor shall field install joint closures after successful completion of all testing. Pre-formed urethane half-shells shall not be acceptable.

I. Provide fittings prefabricated and pre-insulated and having the same material and physical characteristics as for the straight pipe sections. Field fabricated and insulated fittings shall not be acceptable.

1.8 STEAM PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Spence, pilot operated.
   2. Sarco, pilot operated.
   3. Substitutions: As approved by the University.

B. Removable, reusable insulation covers shall be provided for all steam pressure reducing valves.

1.9 PLATE AND FRAME HEAT EXCHANGER

A. Manufacturers:
   1. Alfa Laval; [www.alfalaval.com](http://www.alfalaval.com).
   2. Trantor; [www.trantor.com](http://www.trantor.com).
   4. Substitutions: As approved by the University.

B. Frames: Caron steel with baked epoxy enamel paint, stainless steel side bolts and shroud. Frame to be sized to allow 20% added capacity with additional plates.
C. Plates: Stainless steel type 304.

D. Gaskets: NBRP CLIP-AD.

E. Nozzles: 150 psi rated lined flange type.

F. Insulation: Provide manufacturer's insulation package and drain pan.

G. Warranty: Provide five year manufacturer's warranty.

1.10 METERS

A. BTU metering shall be provided for all buildings connected to the district heating system and for all chilled water systems with a chiller serving multiple buildings.

B. District hot and chilled water BTU metering shall be accomplished with primary supply and return water temperature sensors and a water flow meter. Water flow meters shall be rated for 240 degrees F minimum. Water temperature sensors shall be matched pairs with differential temperature accuracy of at least 0.1 degree F. BAS software shall perform the BTU calculations and log hourly, daily and monthly totals.

C. District steam BTU metering shall be accomplished with mass flow steam meters or with “Cadillac”-type condensate meters and condensate temperature transmitters. BAS software shall perform the BTU calculations and log hourly, daily and monthly totals.

D. Flow Meters

1. Manufacturers:

   b. Siemens (formerly Controlotron) model 1010.
   c. No Substitutions allowed.

2. Clamp-on ultrasonic flow meter with 4-20 milliamp signal scaled to GPM. Meter shall be integrated into the University’s Building Automation System (BAS).

3. Designer shall provide piping drawings which indicate the necessary fifteen (15) pipe diameters of unobstructed horizontal piping with no wells, valves, elbows or other obstructions for the mounting of the flow meter transducers. Vertical pipe with flow up is also acceptable, but vertical pipe with flow down is unacceptable.

4. Flow meter shall include mounting bracket and clamp assemblies. Flow meter shall be insulated in a manner that prevents condensation formation, but allows easy removal and reinstallation for period cleaning and servicing.

1.11 SALVAGING OF REMOVED EQUIPMENT

A. The mechanical contractor shall provide the University, the manufacturer, model number, nominal capacity, and salvage value of all major equipment to be removed as part of this project. The University shall determine the disposition of this equipment. For refrigeration equipment, the contractor shall provide the University the type and

University of New Hampshire
PLANNING, DESIGN AND CONSTRUCTION GUIDELINES

June 7, 2010
estimated quantity of each refrigerant. UNH Facility Operations and Maintenance reserves the option of recovering refrigerants from all equipment being removed by outside contractors.

END OF SECTION 15180

ATTACHMENTS:

Attachment A - District Heating Water Connections and Controls
SECTION 15185 – HYDRONIC PUMPS

1.1 SUMMARY

A. Section Includes:
   2. Vertical In-line Pumps.

1.2 GENERAL

A. If there is sufficient floor space in the mechanical room to allow manufacturer’s recommended service clearances, base mounted pumps shall be used in lieu of in-line pumps.

B. Manufacturers:
   1. Armstrong Pumps Inc.
   2. ITT Bell & Gossett.
   3. Taco, Inc.
   5. Substitutions: As approved by the University.

C. Maintenance:
   1. Provide a minimum of 24” on sides and ends of base mounted pumps and motors to allow access for service and repair.
   2. All pumps shall have isolation valves on suction and discharge sides to allow removal of pumps for service or replacement.
   3. Bleed valves and gauge ports shall be installed at accessible locations.
   4. All pumps shall be serviceable without removing the volute from the piping connections.
   5. A technician certified by the pump manufacturer shall field align flexible coupled pumps after the base has been grouted and flushing and cleaning procedures are completed. Pump and motor shall be aligned in all four planes.

1.3 MOTORS

A. Three-phase motors of 1 horsepower and greater shall be premium efficiency.

1.4 VIBRATION ISOLATION AND SEISMIC CONTROL

A. Provide concrete inertia bases with open spring isolators for base mounted, end suction pumps.

B. Provide open spring isolators with minimum deflection of 1.5 inch for in-line pumps.
1.5 PUMP CONTROL

A. Differential pressure control on pumps shall be provided by VFD’s. Bypass valves may only be used after fully utilizing the maximum turndown from a VFD.

END OF SECTION 15185
SECTION 15400 – PLUMBING

1.1 SUMMARY

A. The design of the plumbing work for all projects performed for the University shall be prepared in accordance with the latest University of New Hampshire Construction and Renovation Standards.

B. Design documents shall be prepared by an entity offering professional design services under a current Certificate of Authority issued by the State of New Hampshire Joint Board of Licensure and Certification.

C. All plumbing documents shall be prepared under the supervision of an employee acting as the responsible engineer for the entity and eligible to be listed on the Certificate of Authority.

D. All construction work shall be provided utilizing licensed plumbers in accordance with the International Plumbing Code for the State of New Hampshire.

E. The University shall act as the Authority having Jurisdiction for the water supply to the project location.

F. The Town of Durham shall be the Authority having Jurisdiction for all drainage systems.

G. No construction work shall proceed without the required appropriate permits being obtained.

H. Design documents shall conform to the most current International Plumbing Code for the State of New Hampshire.

I. Natural gas piping and equipment installation shall conform with the State of New Hampshire Fire Code (NFPA 54).

PART 2 - PRODUCTS

2.1 Underground Services to new construction or additions:

A. Water supply from the main

1. Pipe – ductile iron
2. Valves – non-rising stem gate valves, bronze trim, flanged connections, OPEN LEFT, 150 PSI with curb box.
3. The water entry for the building shall be terminated a minimum of 6 inches above the service entry room floor with a flanged connection.

B. Gas supply (Natural Gas)

1. Pipe - Schedule 80, Black Iron pipe, plastic jacket, welded joints.
2. Pipe fittings – malleable.
4. Cathodic protection to be installed as necessary.
6. Gas Meter –

C. Utility Services inside building:

1. Water supply
   a. Isolation valve at exterior wall, gate valve, bronze trim, flanged connections, OPEN LEFT, 150 psi.
   b. Piping after the isolation valve shall - type "K" copper, lead-free-solder.
   c. Meter - flanged connections, sized to manufacturer's specs, provide a by-pass line around meter. Water meters shall be Badger Meter RCDL disc type with NPT connections or Badger Meter Record all compound type. All meter housings shall be cast bronze. Water meter registers shall read in gallons. Water meters shall have a Badger RTR type head in order to provide both a local register reading and a dry contact pulse output. Compound meters shall have an RTR head on both the low and high sides (two RTRs per meter). Technical information on Badger Meter devices is available from O'Connor & Senecal; Sutton, Massachusetts; 508-865-5600. Output wires from the RTR heads shall be run in conduit to a watertight gasketed 6x6x4 nonmetallic pullbox located on the building exterior, on the side of the building facing an existing University meter reading radio antenna. Locations of existing antennas shall be provided by UNH Energy Office.
   d. Back-flow preventers - one on down stream side of meter and on by-pass. Provide a back flow prevention station immediately downstream of the water meter and its bypass line to contain and protect the water district piping system from any backflow from the building. The station shall include two RPBPs installed in parallel with each valve including isolation valves to allow testing of either valve without shutting down the water supply into the building. The supply of domestic water serving the main potable water distribution piping system shall be taken off down stream of the building containment backflow station. Each branch serving systems requiring protection must include an approved backflow prevention device to prevent backflow from a non potable system into the building systems potable water system. Laboratory water systems serving multiple laboratories shall also be protected with two RPBPs installed in parallel with each valve including isolation valves to allow testing of either valve without shutting down the water supply into the building. Each device serving individual system equipment shall be provided with a dedicated backflow device located within the same room as equipment served. Where system operation is identified as critical, such as a laboratory water system, and not to be shutdown, dual station backflow prevention should be provided for that system.
   e. Vacuum breakers for hose connections in laboratory areas shall not be less than 6 feet (1829 mm) above the floor.
f. The water pressure within the building shall be limited to a maximum pressure of 80 psig. Provide a pressure relief valve in the domestic water line when the available pressure into the building is determined to be too high.

g. Faucets with serrated outlets or fixtures with discharge hoses in laboratory areas shall include a vacuum breaker located a minimum of 6 feet above the floor.

h. Valves - all other valves down stream of meter to be of the ball type, 125 psi at branches and fixtures.

i. Ground rods to be connected before valve and meter (upstream).

j. Booster pumps – Where the water pressure is determined to be inadequate to provide adequate pressure to all the fixtures a booster pump shall be employed. The booster pump equipment shall generally be piped to provide the additionally required pressure in the domestic water system. Pressure requirements must consider pressure drops through backflow devices to non-potable branches served off the domestic water distribution system.

k. Emergency Water System – The emergency water system shall be sized to serve the anticipated simultaneously operating emergency fixtures but no case less than a minimum of two combination emergency shower/eyewash station. A minimum 30 psig pressure at each combination fixture must be provided.

l. Processed Water: Special systems, such as, reverse osmosis, deionized water or other purified water systems, shall to the extent possible, utilize skid mounted equipment. The base system shall employ, dedicated backflow protection, water softening, filtration, a reverse osmosis unit, storage tank, ultraviolet type sterilization chamber, automatic dye feed equipment, distribution pumps, and final distribution. The distribution piping may be PVC. Where central polishing may be required to acquire the determined system water quality the additional space required must be provided near the skid. Provide PP distribution piping serpentine loops with minimal dead legs for water systems designed to provide a resistivity above 1 ohm. System equipment shall be based on Siemens.

m. Trap priming devices shall be provided for all traps subject to evaporation. Trap primers shall be selected to supply water to traps on an adjustable interval through the trap primer device. The device shall include a shut off valve on the branch connection from the water main and the device shall include integral backflow protection and suitable manifold to serve the individual traps served through separate ½” piping to each trap served. Provide deep seal traps with ½’ trap primer connection above the weir level. Lines shall be routed to trap connection with no low points and be pitched to allow all water in the line to discharge into the trap.

2. Sanitary Drainage and Vents.

   a. All buried piping shall be ASTM A 74 Extra Heavy cast iron with hub and spigot joints with rubber gaskets.

   b. Above ground piping shall be ASTM A 888 or CISP 301 Hubless Cast Iron Heavy Duty shielded, stainless steel couplings with a minimum of 4 bands.

   c. Copper DWV, ASTM B 306, cast copper or ASTM B16.29 wrought copper with solder joint fittings.
3. Storm Drainage.

   a. All buried piping shall be ASTM A 74 Extra Heavy cast iron with hub and spigot joints with rubber gaskets.
   b. Above ground piping shall be ASTM A 888 or CISP 301 Hubless cast iron heavy duty shielded, stainless steel couplings with rubber sleeve and a minimum of 4 bands.
   c. Secondary Roof Drainage shall be provided where the structural design is found to be compromised should the primary roof drains be obstructed. Secondary Roof Drains shall have drainage piping be independent of the primary storm drainage system and shall terminate above grade at an easily observed location. Secondary drains shall have weir heights selected to reduce the chances of overflow when the roof drains are not obstructed during a typical design storm condition.


   a. The University policy does not allow the introduction of acid or corrosive material into the drainage system.
   b. Laboratory drainage system shall conform to sanitary system construction unless specifically directed otherwise.

5. Gas (Natural)

   a. Isolation valve - Gas cock 150 psi.
   b. Meter - threaded connections, reads in cubic ft., remote reading unit capability.
   c. Piping - threaded joints, Schedule 40, malleable fittings.
   d. Reducing valves– Reducing valves shall be sized to accommodate equipment specifications. Provide a dedicated pressure reducing valve for elevated gas pressure piping.
   e. Provide shut off valves for kitchen equipment and each laboratory or space with more than one gas outlet or connection and normally used by students.


   a. Electric - copper lined tanks, 460 VAC immersion heaters.
   b. Exchanger - plate type.
   c. Steam converter.
   d. Natural gas fired units - Lochnivar preferred.
   e. Piping - Type "L" copper above grade, Type "K" below grade, and lead free solder for soldered joints joints.
   f. Mixing valves - bronze, flanged connections, maintain 130 system temperature.
   g. Captive air shock absorbers on all lines with solenoid valves, hot or cold.
   h. Non potable hot water heaters shall all be piped from a protected source and isolated from other systems.
   i. Tepid water for emergency water systems shall be sized to serve the anticipated simultaneously operating emergency fixtures but no case less than a minimum of one combination emergency shower/eyewash station.
7. Fixtures and Hardware

a. General

Water closets and urinals shall have automatic flushometers. The University prefers hardwired over battery operated.

b. Water Closets:

1) Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Kingston Model# K-4330 or a comparable product by one of the following:
   a) Kohler Co.
   b) TOTO USA, Inc.
   c) Zurn Plumbing Products Group.

2) Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
   a) Style: Flushometer valve.
   b) Bowl Type: Elongated with siphon-jet design.
   c) Design Consumption: 1.6 gal./flush (6 L/flush).
   d) Color: White.
   e) Flushometer: F-W.
   f) Toilet Seat: TS-1.
   g) Fixture Support: Water-closet support combination carrier.

3) Water Closets, (Accessible): Same as basic water closet and approved and installed to comply with all ADA requirements including mounting height and valve location. Waterless water closets shall not be permitted except when directed by the University.

c. Urinals:

1) Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Bardon Superior Model# K-4960-ET or a comparable product by one of the following:
   a) Kohler Co.
   b) TOTO USA, Inc.
   c) Zurn Plumbing Products Group.

2) Description: Accessible, Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
   a) Type: Washout with extended shields.
   b) Strainer or Trap way: Separate removable strainer with integral trap.
   c) Design Consumption: 0.5 gal./flush (1.9 L/flush).
   d) Color: White.
f) Outlet Size: NPS 2 (DN 50).
g) Flushometer: F-U.

3) Waterless Urinals will not be permitted except when directed by the University.

d. Automatic Flushometers: Toto or Sloan.
e. Lavatories:

1) Basis-of-Design Product: Subject to compliance with requirements, Architect to provide integral sink system or approved equal:
   2) Description: Integral sink system fixture.
      a) Faucet: Lavatory.
      b) Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
      c) Drain: Grid.
      d) Drain Piping: NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) chrome-plated, cast-brass P-trap; NPS 1-1/2 (DN 40), 0.032-inch- (0.8-mm-) thick tubular brass waste to wall; and wall escutcheon.
      e) Hair Interceptor: Not required.
      f) Protective Shielding Guard(s).
      g) Fixture Support: Lavatory.

f. Lavatories, (Accessible):

1) Basis-of-Design Product: Subject to compliance with requirements, Architect to provide integral sink system or approved equal:
   2) Description: Accessible, Integral sink system fixture.
      a) Faucet.
      b) Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
      c) Drain: Grid.
      d) Drain Piping: NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) chrome-plated, cast-brass P-trap; NPS 1-1/2 (DN 40), 0.032-inch- (0.8-mm-) thick tubular brass waste to wall; and wall escutcheon.
      e) Hair Interceptor: Not required.
      f) Protective Shielding Guard(s).
      g) Fixture Support.

h. Individual Showers:

1) Basis-of-Design Product: Subject to compliance with requirements, provide Crane Plumbing ADA Compliant Model# A3636.09F or a comparable product by one of the following:
   a) Acryline USA, Inc.
   b) Aker Plastics Co., Inc.
c) Aqua Bath Company, Inc.
d) Aqua Glass Corporation.
e) Aquatic Industries, Inc.
f) Clarion Bathware.
g) Crane Plumbing, L.L.C./Fiat Products.
h) Jacuzzi, Inc.
i) Kohler Co.
j) LASCO Bathware.
k) Praxis Industries, Inc.; Aquarius Products.
l) Simmons

2) Description: Accessible, PMMA shower enclosure with slip-resistant bathing surface and shower rod with curtain.

   a) Size: 36 by 36 inches (915 by 915 mm).
   b) Surround: One piece.
   c) Color: White.
   d) Drain Location: Center.
   e) Accessibility Options: Include (2) grab bars and fold-up bench.
   f) Faucet.
   g) Drain: Grid, NPS 2 (DN 50).
   h) Misc.: Stainless steel curtain rod and wood blocking for shower head hooks.

h. Individual Showers:

   1) Description: Components for built-up shower.

       a) Faucet.
       b) Receptor: Not Required.
       c) Drain: Trench Drain.
       d) Misc.: Stainless steel curtain rod and wood blocking for shower head hooks.

i. Kitchen Sinks:

   1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

       a) Elkay Manufacturing Co.
       b) Just Manufacturing Company.
       c) Kohler Co.
       d) Moen, Inc.
       e) Sterling Plumbing Group, Inc.
       f) Teka USA.

   2) Description: One-bowl, residential, counter-mounting, stainless-steel kitchen sink.

       a) Overall Dimensions: 22 by 19 inch (559 by 483 mm).
       b) Metal Thickness: #18 gauge.
c) Bowl:

d) Dimensions: 6 inch (152 mm) deep.

e) Drain: 3-1/2-inch (89 mm) grid with offset waste.

f) Location: Near back of bowl.

g) Sink Faucet: SF-1.

h) Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.

i) Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; continuous waste; and wall escutcheon(s).

j) Disposer: Not required.

k) Dishwasher Air-Gap Fitting: Required.

l) Hot-Water Dispenser: Not required.

j. Mop / Service Basins, (MB-1):

1) Basis-of-Design Product: Subject to compliance with requirements, provide Fiat Mop Service Basin Model# MSB-3624 or a comparable product by one of the following:

a) Acorn Engineering Company.
b) Crane Plumbing, L.L.C./Fiat Products.
c) Florestone Products Co., Inc.
d) Precast Terrazzo Enterprises, Inc.
e) Stern-Williams Co., Inc.

2) Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.

a) Shape: Rectangular.
b) Size: 24 by 36 inches (610 by 915 mm).
c) Height: 10 inches (255 mm).
d) Rim Guard: On front top surfaces.
e) Color: Not applicable.
f) Faucet: Sink MBF-1.
g) Drain: Grid with NPS 3 (DN 80) outlet.

k. Water Coolers, (dual station with accessible station):

1) Provide piping design to accommodate both stations operating simultaneously. Design must include adequate pressure at the device location to satisfy manufacturer’s specifications.

2) Basis-of-Design Product: Subject to compliance with requirements, provide Halsey Taylor Barrier-free Cooler Model# OVL-11 SER-Q or a comparable product by one of the following:

a) Elkay Manufacturing Co.
b) Halsey Taylor.
c) Haws Corporation.
d) Oasis Corporation.
3) Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult-mounting height.

   a) Cabinet: Bi-level with two attached cabinets and with bi-level skirt kit, all stainless steel. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
   b) Control: Push bar.
   c) Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
   d) Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
   e) Drain(s): Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.1.
   f) Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
   g) Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
   h) Electrical Characteristics: 370 watts; 120-V ac; single phase; 60 Hz.
   i) Support: Type II, water cooler carrier. Refer to "Fixture Supports" Article.

4) Type I: Hanger-type carrier with two vertical uprights.
5) Type II: Bi-level, hanger-type carrier with three vertical uprights.
6) Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

I. Laboratory Sinks and trim

1) Epoxy sink and trim by other. Provide Water Saver deck mounted gooseneck faucet with wrist blade handles, acid resistant grid drain with 1 1/2"-inch tailpiece, acid resistant “P-trap”. Include ½” flexible supply risers, angle stops, set screw and escutcheons for hot and laboratory water supply. Provide CPVC mixing faucet with vacuum breaker, compression control, deck mounted self closing faucet with ½” flexible supply risers and angle stops set screw and escutcheons, for RO water supply connection.

   a) Provide non-potable labels in compliance with International Plumbing Code typical at all lab type sinks.

m. Cup Sinks: Single epoxy resin with strainer and tailpiece. Supply fitting Water Saver, gooseneck with wrist blade handle, serrated end, polypropylene “P” trap and flexible riser with angle stop.

n. FUME HOODS: Hoods shall not be provided with cup sinks. Confirm hoods are pre-piped for service connection from a single valved off line provided under the plumbing scope.

o. Lab Stainless Steel Sinks:
1) Description: Reuse existing One-bowl, commercial, floor-mounting, stainless-steel sink.
   a) Sink Faucet.
   b) Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.
   c) Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, pipe to below sink; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; continuous waste; and wall escutcheon(s).

p. Lab Outlets
1) Refer to architectural lab trim and fixture schedule for orientation, quantity and laboratory furnishing, drawings for type and locations.
2) Provide turret for deck mounted locations and wall flange for wall mounted locations.
3) Natural gas, vacuum, compressed air outlet shall be water saver type with serrated hose end, ball valve, lever handle with index.
4) Specialty gas outlet shall be Water Saver L4200-FH with Water Saver BO-188 1/4"NPT Quick Connect fitting, ball valve, lever handle with index.
5) Individual air, gas, vacuum and specialty gas outlets installed at exposed piping with backing board shall include outlets with integral check valve.

q. Miscellaneous Supply Fixtures
1) Ice maker connection
   a) General: recessed-mounting outlet boxes with fittings complying with ASME A112.18.1M. Include stainless steel box with faceplate, services indicated for equipment connections, and reinforcement to wall supports.
   b) Ice maker outlet boxes: With hose connection and the following:
   c) Box and faceplate: stainless steel.
   d) Supply fitting: 3/8-inch NPS globe or ball valve and 3/8-inch NPS copper, water tubing.
   e) Supply ice maker from valved off branch piping from domestic water line and include backflow protection.

r. Combination Emergency Shower/Eyewash Units (Recessed):
1) Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Equipment Recessed Laboratory Units Model # GBF2170 or a comparable product by one of the following:
   a) Guardian Equipment Co.
   b) Haws Corporation.
   c) Encon Safety Products.
2) Description: Plumbed, accessible, recessed in wall, with local full port ball valves for isolation.

3) Piping: stainless steel.
   a) Unit Supply: NPS 1-1/4 (DN 32) minimum from top.
   b) Unit Drain: NPS 2 (DN 50) Outlet at bottom.
   c) Shower Supply: NPS 1 (DN 25) with flow regulator and stay-open control valve.
   d) Eye/Face Wash Supply: NPS 1/2 (DN 15) with flow regulator and stay-open control valve.

4) Shower Capacity: Deliver potable water at rate not less than 20 gpm (76 L/min.) for at least 15 minutes.
   a) Control-Valve Actuator: Pull rod.
   b) Shower Head: 10-inch (250-mm) minimum diameter, stainless steel.

5) Eye/Face Wash Equipment: With capacity to deliver potable water at rate not less than 3.0 gpm (11.4 L/min.) for at least 15 minutes. Third party testing is required prior to acceptance by the University.
   a) Control-Valve Actuator: Handle.
   b) Receptor: stainless-steel bowl.

s. Combination Emergency Shower/Eyewash Units (Freestanding):

1) Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Equipment Safety Station Model # G1950P or a comparable product by one of the following:
   a) Guardian Equipment Co.
   b) Haws Corporation.
   c) Encon Safety Products.

2) Description: Plumbed, accessible, freestanding, with emergency shower and eye/face wash equipment.

3) Piping: stainless steel.
   a) Unit Supply: NPS 1-1/4 (DN 32) minimum from top.
   b) Unit Drain: Outlet at side near bottom.
   c) Shower Supply: NPS 1 (DN 25) with flow regulator and stay-open control valve.
   d) Eye/Face Wash Supply: NPS 1/2 (DN 15) with flow regulator and stay-open control valve.

4) Shower Capacity: Deliver potable water at rate not less than 20 gpm (76 L/min.) for at least 15 minutes. Third party testing is required prior to acceptance by the University.
   a) Control-Valve Actuator: Pull rod.
b) Shower Head: 10-inch (250-mm) minimum diameter, ABC Plastic.

5) Solids Interceptors: Shall be installed at all sinks where solids may enter the sanitary waste system.
   a) Zurn Plumbing, Tyler Pipe, Josam Company

6) Eye/Face Wash Equipment: With capacity to deliver potable water at rate not less than 3.0 gpm (11.4 L/min.) for at least 15 minutes. Third party testing is required prior to acceptance by the University.
   a) Control-Valve Actuator: Handle.
   b) Receptor: ABC Plastic.

PART 3 - EXECUTION

3.1 Excavation shall be in accordance with Chapter 5, Division 2.

3.2 Installation of all materials shall be in accordance with applicable codes, standards, and manufacturer’s installation instructions.

3.3 Provide a swing check valve and isolation valve in each pump discharge.

3.4 Provide a backwater valve in piping subject to backflow.

3.5 Installation of all fixtures shall be in accordance with manufacturer’s installation instructions.

3.6 Lavatory hot water supply and drainage piping including architectural millwork and/or other protective systems designed to protect against scalding by exposed piping shall provide knee and toe clearances to the first obstruction as provided for by applicable regulation except that knee clearances shall be increased to no less than 9".

3.7 ADA compliant trap and water line insulation shall be provide for all exposed piping indicated to be accessible.

3.8 Water distribution system shall sized to accommodate future expansion and provide each fixture’s specified minimum input pressure at design flow.

3.9 Provide hangers and supports and include seismic restraints for all systems determined by code to require them.
SECTION 15500 - FIRE PROTECTION

1.1 SUMMARY

A. The design of the plumbing work for all projects performed for the University shall be prepared in accordance with the latest University Construction and Renovation Standards.

B. Design documents shall be prepared by an entity offering professional design services under a current Certificate of Authority issued by the State of New Hampshire Joint Board of Licensure and Certification.

C. All Fire Protection documents shall be prepared under the supervision of an employee acting as the responsible engineer for the entity and eligible to be listed on the Certificate of Authority.

D. All construction work shall be provided utilizing licensed installers in accordance with the State of New Hampshire Fire Code.

E. The University shall act as the Authority having Jurisdiction for the water supply to the project location.

F. The Town of Durham shall be the Authority having Jurisdiction for all fire protection suppression systems.

G. No construction work shall proceed without the required appropriate permits being obtained.

H. Design documents shall conform to the most current State of New Hampshire Fire Code.

I. All new installations and retrofits shall be inspected by the current University Sprinkler System Inspection Contractor during the warrantee period to verify compliance with NFPA Standard No.13 and Durham Fire Department Standards including Appendix A. NFPA 13R shall not be considered for use as an acceptable Design Standard for design of construction for University Projects.

J. At the completion of the project and/or final acceptance testing of the sprinkler system a copy of the Contractor's Certificate showing how the system functioned during the trip test and verifying that the air loss is less than one/half per pound day shall be supplied.

1.2 PRODUCTS

A. Dry Systems shall be avoided. Where used a threaded piping system shall be used and there shall be less than a one/half pound air loss per day. A Victaulic system would only be used with the prior written approval of University Facilities Design and Construction. Where steel pipe is used in preaction and dry pipe systems, piping
materials shall be limited to internally galvanized steel. Air compressor shall not include an air dryer.

B. Plastic pipe shall not be included as an acceptable material for any sprinkler systems.

PART 3 - EXECUTION

A. All drains and test connections for new installations shall be piped to allow full flow.

B. All dry system piping shall include a specified amount of pitch and installed to prevent forming low points or traps. Drains shall terminate within a heated area.

END OF SECTION 15500
SECTION 15510 – BOILERS

1.1 SUMMARY

A. Section Includes:
   2. Condensing Boilers.

1.2 GENERAL

A. Cast Iron Boiler Manufacturers:
   1. Smith Boilers.
   2. Weil McLain.

B. Condensing Boiler Manufacturers:
   1. To be developed.

C. Oil Burner Manufacturers:
   1. Beckett.
   2. Carlin.

END OF SECTION 15510
SECTION 15620 – CHILLERS

1.1 SUMMARY

A. Section Includes:
   1. Air-Cooled Chillers
   2. Water-Cooled Chillers

1.2 SUBMITTALS

A. LEED Submittal:
   1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.

1.3 GENERAL

A. Manufacturers:
   1. Carrier
   2. Trane
   3. York

B. Type of chiller shall be selected based on life cycle cost and approved by UNH.

C. Chillers shall have unloading capability to meet the lowest load on the system.

D. Chiller control panel shall be interfaced with the Building Automation System (BAS). BACnet is the preferred communication protocol. The type of interface shall be reviewed and approved by the University to ensure adequate provisions for communication of necessary information to the campus BAS.

E. Floor drains shall be provided within 25 feet of chillers to permit tube cleaning/head removal maintenance.

F. For larger sized chillers, I-beams should be provided to allow removal of chiller cover plates for annual cleaning.

G. Negative pressure chillers should not be used.

END OF SECTION 15620
SECTION 15640 – COOLING TOWERS

1.1 SUMMARY

A. Section Includes:
   1. Open Cooling Towers.

1.2 GENERAL

A. Manufacturers:
   1. Baltimore Air Coil.
   2. Evapco.
   4. Remsa.

B. Gear driven motors shall be provided on towers with fan motor sizes 20 horsepower and above. Belts on motors of this size need to be adjusted every other week.

C. Tower construction and structural framing shall be stainless steel or fiber glass for durability and longevity.

D. When towers are installed in wells, design must consider options for preventing recirculation of discharge air such as elevating the tower, using discharge stack extensions, etc.

E. Provide a water meter for cooling tower make-up water.

END OF SECTION 15640
SECTION 15720 – AIR HANDLING UNITS

1.1 SUMMARY
A. Section Includes:
   1. Air Handling Units.

1.2 SUBMITTALS
A. LEED Submittal:
   1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.3 MANUFACTURERS
A. Modular Air Handling Units: Carrier, McQuay, Trane.
B. Custom Air Handling Units: Air Enterprises, Haakon.

1.4 SUPPLY FANS
A. Static pressure control on VAV air handlers shall be provided by electronic variable frequency drives. Inlet vane or bypass dampers are not acceptable.

1.5 HEATING COILS
A. All air handling units utilizing any percentage of outside air shall have both coil valve control AND integral factory installed face and bypass damper sections, even units with energy recovery devices. Face and bypass assemblies shall have one continuous face coil section and one continuous bypass section. Assemblies with alternate coil and bypass sections are not acceptable. Below 40 degrees outside air temperature, the coil valve shall remain open and the face & bypass damper shall modulate to maintain setpoint. Above 40 degrees outside air temperature, the face & bypass damper shall remain in full face, and the coil valve shall modulate to maintain setpoint. Energy recovery wheels shall be utilized for all 100% outside air systems. The desiccant wheel shall utilize a "balanced sieve" 4A hygroscopic solid desiccant coating. Wheel shall allow for both sensible and latent heat transfer equally. An independent wheel test from a third party testing agency shall document that the desiccant material on the wheel does not transfer pollutants typically encountered in the indoor air environment.

B. Air handler outside air and return air ductwork shall be of sufficient length and configured so as to prevent any air stratification problems in the mixing box and coil areas.
C. Snow mitigation shall be included for the outside air intake in the design and construction of all new systems.

1.6 FILTER SECTIONS

A. All air handling unit filter racks shall have analog differential pressure transducers, with local manehelic gauge readout, to report filter loading status to the BAS.

B. LEED EQ Credit 5 Indoor Chemical & Pollutant Source Control requires that MERV 13 filters or better be used on outdoor and return air streams.

1.7 DAMPERS AND ACTUATORS

A. The University strongly prefers that all damper actuators be externally mounted when possible.

B. Air handlers, with externally mounted actuators located indoors, shall be provided by the manufacturer with damper shaft extensions that allow all damper motors to be installed exterior to the air handler. External shafts, piping or linkage must not pass through or obstruct the easy operation of access panels necessary for maintenance for that purpose and shall be provided by the equipment manufacturer with shafts extended to the exterior ready for actuator mounting.

C. All air handlers located outdoors shall be provided with weather tight enclosures and damper shaft extensions that allow all damper motors to be installed outside of the system air stream. All such enclosures shall be 3rd party certified and labeled to meet the requirements of the NH State Fire Marshal’s Office (NHSFMO).

D. When internally-mounted actuators are necessary or advantageous, they shall be permitted only when the complete assembly including the air handling unit, actuator and all associated wiring are certified by an independent 3rd party inspection service as approved by the NHSFMO. All interior actuators shall be accessible by hinged access panels of sufficient size to permit easy access, adjustments and removal. Doors or exterior casing will be provided with a view port to allow the position and operation of the actuator to be easily observed. An internal light is required on all AHU’s with an airflow capacity greater than or equal to 15,000 CFM.
SECTION 15830 – FANS

1.1 SUMMARY

A. Section Includes:
   1. Centrifugal fans.
   2. In-line centrifugal fans.
   3. Roof centrifugal fans.

1.2 GENERAL

A. Manufacturers:
   1. Loren Cook
   2. Greenheck
   3. Twin City

B. Fans shall be constructed and rated in accordance with AMCA.

C. All fans of any one type shall be of the same manufacturer.

D. Provide epoxy coating finish as a minimum with additional protective coatings on fans as required by project conditions.

E. Provide AMCA spark resistant construction option: A, B, or C as required by project conditions.

F. Provide open drip-proof NEMA Premium Efficiency rated motor rated for compatibility with variable frequency drives where applicable. Select non-overloading motors at all points on the RPM operating curve.

G. Class of fan shall be determined by the duty specified plus a 15 percent increase in speed.

H. Provide heavy-duty, grease-lubricated, precision anti-friction ball or roller, self-aligning, bearings selected for minimum average life (AFBMA L10) of 200,000 hours.

END OF SECTION 15830
SECTION 16010 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The University incoming electric service facilities to be included under building contract.

1. Overhead Supply to Outdoor Substation:
   a. Secondaries
   b. Metering Space
      1) Instruments
      2) Meters
   c. Yard Grading
   d. Fence
   e. Foundations
   f. Trench for grounding
   g. Conduit for control cable
   h. Auxiliary power and batteries
   i. Space for relay panels
   j. Transformer

2. Underground Supply to a Vault:
   a. Secondaries
   b. Metering space
      1) Instruments
      2) Meters
   c. Conduit on private property
   d. Vault structure
   e. Passageway
   f. Floor drain* (no floor drains if oil filled transformer)
   g. Two (2) doors
   h. Vault lighting
   i. Ventilation
   j. Ground rods
   k. Grounding grid
   l. Transformer

1) *Floor drains shall not be used if transformers contain oil. Provide sump for pumping.
3. Underground Supply to a Vault:

   a. Supply to Pad-Mounted Transformer:
      
      1) Secondaries
      2) Metering
         
         a) Instruments
         b) Metering
      3) Foundations
      4) Conduit on private property
      5) Ground rods and grid

4. Secondary Campus Voltages

   a. 120/240V, 1-phase, 3W (pwr & ltg) 440V, 3-phase, 3W (power).
   b. 240V, 3-phase, 3W (pwr) 480/460V, 3-phase, 3W (power).
   c. 110/220V, 1-phase, 3W (pwr & ltg) 480Y/227V, 3-phase, 4W (pwr & ltg).
   d. 208Y/120V, 3-phase, 4W (pwr & ltg).

5. Primary Distribution System

   a. The campus has a 4160GY/2400 2400/4160 (Y) volt loop primary distribution system. And a 34,500GY/19,900 volt radial primary distribution system. The primary voltage employed for the project shall be verified with University Facilities Design and Construction before wiring design is established.

6. Secondary Distribution System

   a. The secondary voltage employed for the project shall be verified with University Facilities Design and Construction before wiring design is established.

7. Motors

   a. Motors 1/2 horse power and larger shall be wired for 208 volts, 3-phase or 480 volts, 3-phase. All motors shall be of the premium energy efficient type and be designed to operate within the close tolerances of the selected loads. Where starters are required, they shall be in combination with fused (fusetrons) disconnect switches. Final connections to the motors shall be Sealtite.

8. Lighting

   a. Related Requirements Specified Elsewhere
      
      1) Chapter 5, Division 16, Section 16500
      2) Chapter 5, Division 16, Section 16613

B. Definitions
1. Normal Lighting: A building’s normal lighting system necessary to provide lighting for the intended occupation and use of the facility under normal operating conditions.

2. Emergency Lighting: Code required lighting to support the evacuation and egress of a building during an emergency which results in the loss of normal power.

3. Standby Lighting: (and power): Lighting that may or may not be required by code as emergency lighting but provides continued use and operation of a building or protects facilities and assets against loss during an extended power outage or other emergency.

4. Night Lighting: Lighting meant to remain on at all times to produce a reduced light level varying by occupancy and ranging from minimum illumination for security patrols to periods of reduced building activity.

C. Applicability

1. Designs for all new construction and complete-building renovations of University buildings, “Primary Facilities” or “Secondary Support Facilities,” shall be equipped with an emergency power system capable of providing power for code required emergency and exit lighting systems.

2. In “Primary Facilities,” except in utility spaces such as mechanical room’s, etc., emergency lighting shall be incorporated into the building’s normal use lighting system, a separate emergency lighting system shall be prohibited unless specifically approved. Separate emergency lighting systems are permissible in “Secondary Support Facilities”.

3. As an energy conscious institution, the University is seeking every opportunity to save energy through shutting off lighting when not needed. Also, it must be recognized that there are various rooms and functions which require room darkening to take place. (Note: emergency light systems and night light systems do not provide the same functions, and will not usually be the same system.)

4. Designs for all new construction and complete-building renovations of University buildings defined as either “Primary Facilities” or “Secondary Support Facilities,” may be additionally equipped or expanded to provide a standby power system to enable either continued operations and/or protection of goods and property where programmed to occur or warranted for consideration. There may be rare occasions where a standby power system may be requirement of code because of the facility, occupancy, or use.

5. Designs for other renovations or alterations shall include emergency power systems as required by code, and may include standby power systems if programmed or warranted for consideration.

6. All new construction or complete-building renovations should be designed with either a night light system or the ability to turn lights off as applicable to the particular occupancy.

D. Metering

1. Electric meters shall be provided with dry contact pulse outputs and a local register readout. Meters with pulsing units that generate a voltage impulse are not acceptable. Pulse rates shall be no faster than 1 pulse per second. The BAS contractor shall run a pair of wires from each electric meter pulser to a 6x6x4 non-metallic weatherproof junction box located on the building exterior wall.
next to the gas (if applicable) meter for UNH installation of a meter reading radio transmitter.

2. Meters shall also have standard numerical register for local reading. The contractor providing the meter is responsible for factory startup and calibration of the meter and coordination to ensure that meter pulse output meets requirements of University radio meter reading system. Radio meter reading specifications shall be included in the electrical specifications as required, with applicable CT, PT ratios, and multipliers labeled directly on the meter.

END OF SECTION 16010
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS

CONDUIT

SECTION 16111 - CONDUIT

PART 1 - GENERAL

1.1 All wiring shall be installed in concealed conduit. Minimum conduit size shall be 3/4". The type and material shall be suitable for the intended application.

A. Surface or exposed conduit is acceptable in mechanical rooms, telephone closets and similar applications. Other exceptions may be allowed only where approved by the Owner.

B. Flexible Metal Conduit ¾" minimum trade may be used in concealed locations.

1. Flexible Metal Conduit shall be full wall galvanized steel.
2. All full wall galvanized steel flexible metal conduit systems shall use listed steel fitting.
3. Exceptions;
   a. Flexible metal conduit of 3/8" electrical trade size can be used but only for recessed light fixtures--length not to be in excess of 6'-0".
   b. Flexible metal conduit of ½" electrical trade size can be used for recessed light fixtures length not to be in excess of 6'-0", or drops down the inside of a wall to a single device such as one switch or one receptacle. (any applications that require more than one device will require ¾” minimum trade size FMC) as indicated above.
4. Use of MC type cable is generally not permitted, however Greenfield cable use in small length is allowed (under 6'). Exceptions will be considered by the Owner only where the cable will be fully accessible. (See Chapter 5, Division 16, Section 16123.)

1.2 All EMT conduit systems shall use steel fittings with set screws. 1/2" through 1" fittings shall have a single set screw; 1-1/4" through 4" shall have two set screws in line on each side of the fitting. (Exception): EMT used in damp or wet locations shall use compression type fittings. Diecast fittings are NOT allowed.

1.3 All conduit/raceway that are surface mounted in finished areas shall be painted to match the existing surfaces.

1.4 Where direct-burial wiring is to be extended outside building proper, install rigid conduit through foundation wall and to a point 5'0" outside building proper and provide a watertight seal.

1.5 All underground conduits containing medium voltage cable shall be encased in reinforced concrete minimum 3" cover top, bottom and sides.
1.6 All underground conduits containing medium voltage cable shall be PVC (5") Five inch minimum size except provide 6" minimum for primary campus circuits.

1.7 All underground conduits containing medium voltage cable with elbows and Off sets greater than 30 degrees shall be (RGC) rigid galvanized conduit elbows and offsets.

1.8 All (RGC) rigid galvanized conduit and fittings buried below finish grade shall be field coated with asphaltum or shall have an additional outside factory coating of polyvinyl chloride or a phenolic resin epoxy material.

1.9 The first 10’-0” of conduit that rises out of the ground and up the side of a building or up a telephone/power pole shall be (RGC) rigid galvanized conduit.

PART 2 - PRODUCTS

2.1 The following conduit system components shall be submitted to the client for approval:

A. PVC Conduit.
B. PVC Fittings.
C. PVC High Impact Spacers.
D. RGC, IMC, & EMT.
E. RGC, IMC, & EMT Fittings.
F. Conduit Sealing Fittings.

END OF SECTION 16111
PART 1 - GENERAL

1.1 UNDERGROUND CABLE

   A. EPR Power Cable 35000 volts: Single Conductor, Shielded, 100% Insulation Level, AEIC-CS-6, MV-90 or MV-105 Sunlight Resistant, CT, USE.

   B. ERP Power Cable 5000/8000 volts: Single conductor, Shielded, 133% Insulation Level, AEIC-CS-6, MV-90 or MV-105 Sunlight Resistant, CT, USE.

   C. Cable Components for both 5000/8000 & 35000 volt cable (A & B).
      1. Conductor to be copper wire only
      2. Shielding to be copper tape only
      3. All medium voltage underground cable shall be installed in conduit encased in reinforced concrete with minimum 3" cover top, bottom and sides. Message
      4. All medium underground cable runs shall include a full size bare stranded neutral conductor, run with the ungrounded insulated phase conductors.
      5. The minimum allowable wire size for 5kV shall be #2 AWG Stranded Copper.
      6. The minimum allowable wire size for 35kV shall be 1/0 AWG Stranded Copper.

1.2 AERIAL MEDIUM VOLTAGE

   A. ACSR Type Cable

   B. Hendrix Cable System

1.3 AERIAL SECONDARY VOLTAGE

   A. ACSR Type Cable

   B. Multiplex Type Cable
      1. Duplex
      2. Triplex
      3. Quadruplex

1.4 MEDIUM VOLTAGE TERMINATION

   A. Elastomeric Type shall be used.

   B. Single-Piece Terminators

   C. Stress Cones
D. Splices
E. Loadbreak Elbows
F. Loadbreak Junctions
G. Cable Shield Adapters
H. Grounding Devices

PART 2 - PRODUCTS

2.1 The following Medium Voltage Cable components shall be submitted to the client for approval:

A. Medium Voltage Underground Cable
B. Medium Voltage Overhead Cable
C. Low Voltage Cable below 600 volts
D. Medium Voltage Terminations

END OF SECTION 16121
PART 1 - GENERAL

1.1 All wire shall be copper and stranded including all branch circuit wiring. No solid conductors shall be used except for certain controls. Exception: High Voltage Aerial and Secondary Voltage Aerial may be aluminum cable.

A. The minimum size shall be No. 12, with "THHN." Grounding conductors shall be stranded.

B. Branch circuits shall be designed so that the maximum voltage drop will be 2% for distribution and 3% for branch circuit.

C. Any 20 ampere branch circuit exceeding 100 feet in length shall be wired with not less than #10 wire from panel to first fixture.

D. Direct burial wire is not allowed by the University.

E. In general, all electrical devices shall be connected so that the removal of a device (pig tails) shall not interrupt conductor continuity.

F. Wire splices and taps, using wire nuts, shall be of the full current rating of the wire without soldering.

G. AC and MC type cable shall not be allowed.

1. Exception:
   a. Galvanized MC may be used in accessible areas for lighting whips, provided the MC is supported per NEC. Minimum trade size shall be #12 AWG. (above suspended ceilings.)

H. The loading of 20 amp branch circuits shall not exceed 80 percent.

I. Convenience outlets shall be considered as a minimum load of 250 watts per duplex outlet.

J. All 120Volt & 277Volt single phase electrical circuits wired on campus shall have a full size dedicated neutral. Splitting/sharing of neutrals shall not be allowed. Exceptions for wiring pre-wired furniture or other equipment shall be done on a case by case basis.

PART 2 - PRODUCTS

2.1 The following building cables shall be submitted to the client for approval:

A. Low voltage Cable 600 volts and below.
B. MC Cable Galvanized.

END OF SECTION 16123
SECTION 16130 – BOXES AND FITTINGS

PART 1 - GENERAL

1.1 In hollow tile partitions, the mounting dimensions may be varied somewhat to suit the mortar joints. "Gem" boxes and shallow handy boxes shall not be used except where limited space will not permit the use of large boxes and then only with University Facilities Design and Construction's permission in writing.

1.2 Outlet boxes for exterior vapor-proof lighting fixtures shall be an integral part of the fixture, as provided by the fixture manufacturer. Outlet boxes shall be cast iron, have watertight covers. PVC boxes and conduit systems may be used in certain approved applications.

1.3 All ceiling outlets shall be located with due consideration as to clearance from ventilating ducts and mechanical piping. Where numerous ducts occur, conduits and outlets shall be installed after ventilating ducts are in place.

1.4 Conduits having runs of more than 100 feet or more than four right angle bends shall have suitable pull boxes installed in convenient locations. All such pull boxes shall be shown on the contractor's "As Built" drawings. Pull boxes shall be supported independently of the conduits and shall be accessible after the completion of the building.

1.5 Outlet boxes shall not be installed back-to-back but shall be staggered.

1.6 All devices, light fixtures, etc., in resident halls shall employ tamper-proof screws.

1.7 EMT fittings shall be steel fittings with set screw. Diecast fitting are NOT allowed. 1/2" through 1" fittings shall have a single set screw per fitting, 1-1/4" through 4" fittings shall have two set screws in line per connector and four set screws in line per coupling.

END OF SECTION 16130
SECTION 16141 – WIRING DEVICES

PART 1 - GENERAL

1.1 Boxes for all devices shall be recessed. Surface mounting is permitted in mechanical rooms, telecommunication closets and similar applications, or as approved by the Owner.

1.2 Local and Miscellaneous Switches.
   A. All local switches shall be rated 20 amp 120/277 V.A.C. and back and side wired and shall be COMMERCIAL SPECIFICATION GRADE.
   B. All switches shall be mounted at the height required to meet ADA standards.

1.3 All receptacles shall be 20 amp minimum at rated voltage, back and side wired and shall be COMMERCIAL SPECIFICATION GRADE.

1.4 Appurtenances.
   A. Note: Pilot lights shall be provided on all switches for vaults, fans, attics and other non-visible lights and motors.

1.5 Wall Plates.
   A. Wall plates shall be 302/304 Premium Stainless Steel for use in labs and other demanding environments. High-Impact Nylon Wall Plates shall be used in all other specified locations. All multi-gang wall plates shall be one piece, no sectional wall plates will be permitted.

1.6 Receptacle Locations.
   A. Place in all corridors and not more than 50 feet apart one 5352 receptacle in one box with cover. Serve outlet with #10 wire from a single pole 20 amp breaker. Ground outlets by rigid conduit and separate grounding wire. This circuit shall be a dedicated system for corridors only. Place 5352 receptacles in stairs on alternate floors, and circuit them using #10AWG.
1.7 Use pig tails to connect receptacles to the neutral conductor in all applications.

1.8 All devices having a grounding terminal shall have a bonding jumper installed tied directly to the equipment grounding conductor. (No exceptions).

PART 2 - PRODUCTS

2.1 NOTE: Proprietary information to be used as guide UL equipment that is commercial specification grade may be allowed. Provide submittal for acceptance.

A. Switches  
   COMMERCIAL SPECIFICATION GRADE

B. Receptacles  
   COMMERCIAL SPECIFICATION GRADE

C. Plates.

D. Appurtenances.

END OF SECTION 16141
SECTION 16170 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 Grounding shall be done at the service entrance equipment in each building by connecting the neutral bus of the service equipment to a grounding electrode, street side of the water meter if the water service is a metal water lines. The metal cabinet of the service equipment must also be connected to the neutral bus in order to provide equipment grounding. Building steel columns shall be bonded to the grounding system grid.

1.2 If a metal water line does not service the building other means of grounding shall be applied. Each building must have a grounding electrode for its service. The proper grounding electrode system will be determined by the Engineer/Owner and will comply with all applicable codes.

1.3 Provide UL approved mechanical grounding connectors to ground water piping with no. 4/0 copper to ground system. Ground all roof mounted fans, pipes, ducts, railings, and other metallic equipment per NEC requirements.

1.4 Under no circumstances is the electrical neutral to be used as an equipment ground beyond the point of the service entrance equipment.

1.5 Under no circumstances is the electrical neutral to be tied to the equipment ground except as stated above.

1.6 All raceway, conduit systems shall have an equipment grounding conductor pulled in with the other conductors beyond point of service. Each joint and termination must be tight so that there is electrical continuity.

1.7 All junction boxes, pull boxes, switch boxes, outlet boxes, etc., shall be bonded to the equipment grounding conductor by means of a green bonding jumper and screw.

1.8 All devices (switches/receptacles etc.) having a grounding terminal shall have a bonding jumper installed tied directly to the equipment grounding conductor. (No exceptions).

1.9 All metal buildings shall be grounded at each major structural steel column to an exterior grounding ring.

1.10 Care shall be taken not to create a parallel path to the neutral conductor by any other means of grounding.

1.11 The grounding for all Separately Derived Alternating – Current Systems shall comply with the Separately Derived Alternating – Current Systems drawing that has been approved by the State Electrical Inspector and in compliance with NEC 250.30, (A) (1) through (6) for installation’s on the University Durham Campus.

1.12 Building service grounding shall be in compliance with NEC 250. See Exhibit #1.
1.13 The grounding for all Two or More Buildings or Structures Supplied from a Common Service shall comply with the Two or More Buildings or Structures Supplied from a Common Service drawing that has been approved by the State Electrical Inspector and in compliance with NEC 250.32, (B), (2) Grounding Conductor for installation’s on the University Durham Campus. (See Exhibit #2). Exhibit below doesn’t reflect two buildings, in addition the exhibit is an image that we can’t modify, we need the original sketch.
END OF SECTION 16170
SECTION 16195 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 One copy of the electrical distribution diagram and fire alarm system diagram shall be located at the main distribution equipment.

1.2 Distribution Panels, Starters, Disconnect Switches, Circuit Breakers.

A. All electrical devices including distribution panels, starters, disconnect switches, circuit breakers shall be identified by one of the following methods or as directed by the Owner.

1. With laminated black with white letters phenolic plates engraved all letters shall be a minimum of ¼” high.
2. With white letters on black vinyl versa labels. All letters shall be a minimum of ¼” high.

B. Example:

<table>
<thead>
<tr>
<th>Line 1 - LPI-N, PPI-N</th>
<th>Line 2 - 208Y/120V - 3 phase 4W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use markers to identify feeders with size and source.</td>
<td></td>
</tr>
<tr>
<td>Starters</td>
<td>Circuit Breakers</td>
</tr>
<tr>
<td>Line 1</td>
<td>Supply Fan S-1</td>
</tr>
</tbody>
</table>

1.3 Compartmental Transformers

A. Pad-mounted transformers shall be identified in upper left-hand corner by one of the following methods or as directed by the Owner.

1. With 2” high, yellow stenciled letters.
2. With 4” black on yellow versa labels.

| Line 1 - Primary voltage - 4160V |
| Line 2 - Secondary voltage - 208Y/120V |
| Line 3 - Capacity - 300 KVA 3 phase 4W |

B. All pad mounted transformers shall have a vinyl sign attached to the main access door the sign shall be a minimum of 10”x14” and state DANGER HIGH VOLTAGE.

PART 2- PRODUCT
2.1 The following Identification system components shall be submitted to the client for approval:

A. Labels.

B. Signs.

END OF SECTION 16195
SECTION 16269 – VARIABLE FREQUENCY DRIVES

1.1 SUMMARY

A. Section Includes:

1. Solid-state, PWM, variable frequency drives for speed control of three-phase, squirrel-cage induction motors.

1.2 GENERAL

A. Manufacturers:

1. ABB.
2. Square D.
3. Yaskawa.
4. Substitutions are not allowed.

B. All variable frequency drives for a particular project shall be provided by the Electrical Contractor and shall be of a single manufacturer.

C. Integral bypass switches that allow operation of the motor via line power in the event of VFD failure shall be provided on drives that are serving equipment without a standby only.

D. Hand-off-auto switches shall only be provided on drives that are not controlled by the Building Automation System (BAS).

E. When controlled by the Building Automation System (BAS), the following minimum points shall be provided:

1. Enable (DO)
2. Speed (AO)
3. Current/Load (AI)
4. Fault (DI)

END OF SECTION 16269
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS
DISTRIBUTION TRANSFORMERS

SECTION 16321 – DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 All transformers purchased for use at the University after August 1, 2009, shall meet the DOE 2010 energy code.

PART 2 - PRODUCTS

2.1 DEAD FRONT OIL-FILLED 35KV PAD-MOUNT TRANSFORMERS

   A. This type of transformer shall be used on all new construction that require pad-mounted equipment or as directed by the Owner.

      1. The transformers shall be: ----KVA, 34,500 Grd.Y/19,920 Volt 3 phase loop feed primary, 65 degrees C rise, 60 Hz, 150 kV BIL, ----/--- Volt 3-phase secondary, Envirotex FR3 high flash point oil insulated, self-cooled, externally removable bayonet type overload sensing fuses in series with a properly coordinated partial range current limited fuse, primary taps, loop feed high voltage load-break switch, externally clamped high voltage RTE Large Interface 200 Amp Load break Bushings, externally clamped secondary bushings, steel divider between the high voltage side and the low voltage side, 1” NPT filler plug, drain valve with sampling device, liquid level gauge, liquid temperature gauge, pressure vacuum gage, automatic pressure relief valve, hand hole in the top of the tank.
      2. All transformers & liquids shall comply with UL, FMRC, ANSI and NEMA industry standards.
      3. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling
      4. Envirotex FR3 high flash point oil insulated UL Listed and FM Approved, proof of non-P.C.B. oil.
      5. Externally removable bayonet type overload sensing expulsion fuses in series with properly coordinated partial range current limited oil submersible fuses to clear high current faults. The bayonet fuse operators shall be located in the high voltage compartment. The partial range current limited fuses shall be located inside the tank and under oil.
      6. The transformer shall have an externally operated primary tap changer with taps, 2 – 2½ % above and 2 - 2½ % below, control switch shall be located in the high voltage compartment.
      7. Loop Feed high voltage load-break switch shall be located in the high voltage compartment.
      8. Externally clamped high voltage RTE Large Interface 200 Amp Load break Bushings shall be located in the high voltage compartment.
      9. Elbow type 27KV lightning arresters shall be mounted on one set of the loop feed bushings located in the high voltage compartment.
     10. Drain valve with sampling device shall be located in the high voltage compartment.
     11. Steel divider between the high voltage compartment and the low voltage compartment.
12. Externally clamped low voltage bushings, low voltage bushing terminals shall be plated to accommodate aluminum/copper conductors, located in the low voltage compartment.

13. 1” NPT filler plug shall be located in the low voltage compartment.

14. Automatic pressure relief valve shall be located in the low voltage compartment.

15. Pressure vacuum gage shall be located in the low voltage compartment.

16. Liquid level gage shall be located in the low voltage compartment.

17. Liquid temperature gauge shall be located in the low voltage compartment.

18. Secondary voltage shall be as listed within the specification or as shown on the drawing.

2.2 CSP OIL-FILLED 35KV POLE-MOUNT TRANSFORMER

A. The transformer shall be: ---KVA, 34,500GY/19,920 Volt single phase primary, 65 degrees C rise, 60 Hz, Class A, additive polarity, 150 kV BIL, ----/--- Volt single phase secondary, oil insulated, primary protective link, surge arrester, secondary circuit breaker, single position pole mounting.

B. All transformers shall comply with ANSI and NEMA industry standards.

C. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).


E. Internal primary protective link under oil.

F. High voltage cover mounted bushing, bushing terminal shall be plated to accommodate aluminum/copper conductors.

G. Low voltage side wall mounted bushings, terminals shall be plated to accommodate aluminum or copper conductors.

H. Secondary circuit breaker shall have an externally operated handle with emergency overload reset and a overload signal light.

I. 27kv surge arrester.

J. The transformer shall have an externally operated tap changer with tap's, 2 - 2-1/2% above and 2 - 2-1/2% below.

K. Automatic pressure relief device.

L. Secondary voltages shall be as listed within the specification or as shown on the drawing.

2.3 CONVENTIONAL OIL-FILLED 35KV POLE-MOUNT TRANSFORMERS
A. The transformer shall be: ---KVA, 34,500GY/19,920 Volt single phase primary, 65 degrees C rise, 60 Hz, Class A, additive polarity, 150 kV BIL, ----/--- Volt single phase secondary, oil insulated, primary protective link, single position pole mounting.

B. All transformers shall comply with ANSI and NEMA industry standards.

C. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).


E. Internal primary protective link under oil.

F. High voltage cover mounted bushing, bushing terminal shall be plated to accommodate aluminum/copper conductors.

G. Low voltage side wall mounted bushings, terminals shall be plated to accommodate aluminum or copper conductors.

H. The transformer shall have an externally operated tap changer with taps, 2 – 2 1/2% above and 2 - 2-1/2% below.

I. Automatic pressure relief device.

J. Secondary voltages shall be as listed within the specification or as shown on the drawing.

2.4 Dead Front Oil-Filled 5kv Pad-Mount Transformers

A. This type of transformer shall be used on all new construction that requires pad-mounted equipment or as directed by the Owner.

B. The transformers shall be: ----KVA, 4160Grd.Y/2400 Volt 3 phase loop feed primary, 65 degrees C rise, 60 Hz, 60 kV BIL, ----/---Volt 3 phase secondary Envirotemp FR3 high flash point oil insulated, self-cooled, externally removable bayonet type overload sensing fuses in series with properly coordinated partial range limited current fuses, primary taps, loop feed high voltage load-break switch, externally clamped high voltage 200 Amp loadbreak bushing, externally clamped secondary bushings, steel divider between the high voltage side and the low voltage side, 1” NPT filler plug, drain valve with sampling device, liquid level gage, liquid temperature gauge, pressure vacuum gage, automatic pressure relief valve, hand hole in the top of the tank.

C. All transformers & liquids shall comply with UL, FMRC, ANSI and NEMA industry standards.

D. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).
E. Envirotemp FR3 high flash point oil insulated UL Listed and FM Approved, proof of non-P.C.B. oil.

F. Externally removable bayonet type overload sensing expulsion fuses in series with properly coordinated partial range current limited oil submersible fuses to clear high current faults. The bayonet fuse operators shall be located in the high voltage compartment. The partial range current limited fuses shall be located inside the tank and under oil.

G. The transformer shall have an externally operated primary tap changer with taps, 2 - 2-1/2 % above and 2 - 2-1/2 % below, control switch shall be located in the high voltage compartment.

H. Loop Feed high voltage load-break switch shall be located in the high voltage compartment.

I. Externally clamped high voltage 200 Amp load break bushings shall be located in the high voltage compartment.

J. Elbow type 3KV lightning arresters shall be mounted on one set of the loop feed bushings located in the high voltage compartment.

K. Drain valve with sampling device shall be located in the high voltage compartment.

L. Steel divider between the high voltage compartment and the low voltage compartment.

M. Externally clamped low voltage bushings, low voltage bushing terminals shall be plated to accommodate aluminum/copper conductors, located in the low voltage compartment.

N. 1" NPT filler plug shall be located in the low voltage compartment.

O. Automatic pressure relief valve shall be located in the low voltage compartment.

P. Pressure vacuum gage shall be located in the low voltage compartment.

Q. Liquid level gage shall be located in the low voltage compartment.

R. Liquid temperature gauge shall be located in the low voltage compartment.

S. Secondary voltage shall be as listed within the specification or as shown on the drawing.

2.5 Live Front Oil-Filled 5kv Pad-Mount Transformers

A. Live front transformers will only be used to replace existing live front transformers or as otherwise directed by the Owner.

1. The transformer shall be: ----KVA, 4160Y/2400 Volt 3 phase radial feed primary, 65 degrees C rise, 60 Hz, 60 kV BIL,-----/---- Volt 3 phase secondary, Envirotemp FR3 high flash point oil insulated, self-cooled, externally removable bayonet type overload sensing fuses in series with properly coordinated partial range current limited fuses, primary taps,
radial feed high voltage load-break switch, externally clamped high voltage bushing, externally clamped secondary bushings, steel divider between the high voltage side and the low voltage side, 1” NPT filler plug, drain valve with sampling device, liquid level gage, liquid temperature gauge, pressure vacuum gage, automatic pressure relief valve, hand hole in the top of the tank.

2. All transformers & liquids shall comply with UL, FMRC, ANSI and NEMA industry standards.

3. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).

4. Envirotemp FR3 high flash point oil insulated UL Listed and FM Approved, proof of non-P.C.B. oil.

5. Externally removable bayonet type overload sensing expulsion fuses in series with properly coordinated partial range current limited oil submersible fuses to clear high current faults. The bayonet fuse operators shall be located in the high voltage compartment. The partial range current limited fuses shall be located inside the tank and under oil.

6. The transformer shall have an externally operated primary tap changer with taps, 2 - 2-1/2 % above and 2 - 2-1/2 % below, control switch shall be located in the high voltage compartment.

7. Radial Feed high voltage load-break switch shall be located in the high voltage compartment.

8. Externally clamped high voltage bushings, high voltage bushing terminals shall be plated to accommodate aluminum/copper conductors, located in the high voltage compartment.

9. 3KV lightning arresters shall be located in the high voltage compartment.

10. Drain valve with sampling device shall be located in the high voltage compartment.

11. Steel divider between the high voltage compartment and the low voltage compartment.

12. Externally clamped low voltage bushings, low voltage bushing terminals shall be plated to accommodate aluminum/copper conductors, located in the low voltage compartment.

13. 1” NPT filler plug shall be located in the low voltage compartment.

14. Automatic pressure relief valve shall be located in the low voltage compartment.

15. Pressure vacuum gage shall be located in the low voltage compartment.

16. Liquid level gage shall be located in the low voltage compartment.

17. Liquid temperature gauge shall be located in the low voltage compartment.

18. Secondary voltage shall be as listed within the specification or as shown on the drawing.

2.6 LIVE FRONT OIL-filled 5kv pad-mount transformers

A. Live front transformers will only be used to replace existing live front transformers or as otherwise directed by the Owner.

1. The transformer shall be: ----KVA, 4160 Volt 3 phase Delta primary, radial feed primary, 65 degrees C rise, 60 Hz, 60 kV BIL,----/--- Volt 3 phase
2. All transformers & liquids shall comply with UL, FMRC, ANSI and NEMA industry standards.
3. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).
4. Envirotemp FR3 high flash point oil insulated UL Listed and FM Approved, proof of non-P.C.B. oil.
5. Externally removable bayonet type overload sensing expulsion fuses in series with properly coordinated partial range current limited oil submersible fuses to clear high current faults. The bayonet fuse operators shall be located in the high voltage compartment. The partial range current limited fuses shall be located inside the tank and under oil.
6. The transformer shall have an externally operated primary tap changer with taps, 2 - 2-1/2 % above and 2 - 2-1/2 % below, control switch shall be located in the high voltage compartment.
7. Radial Feed high voltage load-break switch shall be located in the high voltage compartment.
8. Externally clamped high voltage bushings, high voltage bushing terminals shall be plated to accommodate aluminum/copper conductors, located in the high voltage compartment.
9. 3KV lightning arresters shall be located in the high voltage compartment.
10. Drain valve with sampling device shall be located in the high voltage compartment.
11. Steel divider between the high voltage compartment and the low voltage compartment.
12. Externally clamped low voltage bushings, low voltage bushing terminals shall be plated to accommodate aluminum/copper conductors, located in the low voltage compartment.
13. 1” NPT filler plug shall be located in the low voltage compartment.
14. Automatic pressure relief valve shall be located in the low voltage compartment.
15. Pressure vacuum gage shall be located in the low voltage compartment.
16. Liquid level gage shall be located in the low voltage compartment.
17. Liquid temperature gauge shall be located in the low voltage compartment.
18. Secondary voltage shall be as listed within the specification or as shown on the drawing.

2.7 CSP Oil-Filled 5kv Pole-Mount Transformer

A. The transformer shall be: ---KVA, 4160Y/2400 Volt single phase primary, 65 degrees. C rise, 60 Hz, Class A, additive polarity, 60 KV BIL, ----/--- Volt single
phase secondary, oil insulated, self-cooled, primary protective link, surge arrester, secondary circuit breaker, single position pole mounting.

B. All transformers shall comply with ANSI and NEMA industry standards.

C. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).


E. Internal primary protective link under oil.

F. High voltage, side wall mounted bushings, bushing terminals shall be plated to accommodate aluminum or copper conductors.

G. Low voltage, side wall mounted bushings, bushing terminals shall be plated to accommodate aluminum or copper conductors.

H. Secondary circuit breaker shall have an externally operated handle with emergency overload reset and a overload signal light.

I. 3kv surge arrester.

J. The transformer shall have an externally operated tap changer with taps, 2 - 2-1/2% above and 2 - 2-1/2% below.

K. Automatic pressure relief device.

L. Secondary voltages shall be as listed within the specification or as shown on the drawing.

2.8 Conventional oil-filled 5kv pole-mount transformers

A. The transformer shall be: ---KVA, 4160Y/2400 Volt single phase primary, 65 degrees C rise, 60 HZ, Class A, additive polarity, 60 kV BIL, ----/--- Volt single phase secondary, oil insulated, self-cooled, primary protective link, single position pole mounting.

B. All transformers shall comply with ANSI and NEMA industry standards.

C. Transformer Energy efficiency shall meet the minimum requirements of the DOE October 12, 2007 ruling (referred to as the Final Ruling becoming law effective January 1, 2010).


E. Internal primary protective link under oil.

F. High voltage, side wall mounted bushings, bushing terminals shall be plated to accommodate aluminum or copper conductors.
G. Low voltage, side wall mounted bushings, bushing terminals shall be plated to accommodate aluminum or copper conductors.

H. The transformer shall have an externally operated tap changer with taps, 2 - 2-1/2% above and 2 - 2-1/2% below.

I. Automatic pressure relief device.

J. Secondary voltages shall be as listed within the specification or as shown on the drawing.

K. All transformers data sheets shall be submitted to the client for approval:

END OF SECTION 16321
SECTION 16461 – DRY TYPE TRANSFORMER

PART 1 - GENERAL

1.1 Dry-type transformer KVA, Primary Voltage, and Secondary Voltage shall be as listed within the specification or as shown on the drawings and have a UL Class 220 deg. C insulation system, 150 deg. C temperature rise under full load for Single Phase Units 15-250 KVA & Three Phase Units 15-500 KVA. UL Class 180 deg. C insulation system, 115 deg. C temperature rise under full load for Single Phase Units 0.5-10 KVA & Three Phase Units 3-9 KVA, UL Class 105 deg. C insulation system, 55 deg. C temperature rise under full load for Single Phase Units 15-250 KVA. Transformer shall be listed by Underwriters' Laboratories, Inc., and comply with the latest NEMA and ANSI standards. All systems shall be Delta-Y 600 Volts and below unless indicated otherwise by the Owner. All Medium Voltage transformers above 600 Volts shall be Grounded Y unless indicated otherwise by the Owner. All transformers purchased for use at UNH after August 1, 2009, shall meet the DOE 2010 energy code.

1.2 Neutral terminal ("Xo") of the transformer shall be grounded to building ground.

1.3 Transformer shall have taps on the primary winding with ratings of 2 to 2-1/2% full capacity above normal and 2 to 2-1/2% full capacity below normal. The core assemblies shall be permanently grounded to the enclosure with a flexible conductor of adequate size. The 2-phase wye connected transformer shall be provided with a flexible conductor for grounding the neutral.

1.4 The transformer shall be tested and certified not to exceed sound levels established by NEMA standards. The core and coil assembly shall be mounted on isolating pads so as to effectively dampen vibration transmission to the enclosure with no metal-to-metal contact.

1.5 The transformer enclosure shall be constructed of heavy-gauge sheet steel. Ventilated openings shall not allow the insertion of any rod of 1/2" diameter into the transformer enclosure. The enclosure shall have removable panels to permit access to transformer terminals. A threaded ground stud shall be provided on the exterior of the enclosure to conform to the requirements of Article 250 of the National Electrical Code. On larger units, lifting lugs shall be provided at top for ease of handling. Each enclosure shall be cleaned, phosphatized, primed and painted with baked enamel.

1.6 All connections to transformers shall be made with flexible conduit.

1.7 All transformers used on the exterior shall have a weather rated enclosure.

1.8 Energy efficiency for all transformers shall meet the minimum requirements of the DOE CSL-3 standards (Candidate Standard Level 3).

1.9 The bid price for the CSL-3 dry distribution transformers specified (277/480 to 120/208 V) must be identified (priced) separately within the electrical bid and cannot be included in the bid pricing for other electrical distribution equipment that falls under
Section 16 of the Standard AIA Specification Structure. If specified CSL-3 transformers are not separately identified in the bid pricing then the entire bid will be disqualified.

1.10 Harmonic cancelling transformers shall be used for laboratory loads, and other concentrated non linear load spaces.

1.11 Generally accepted equipment. Provide submittal for approval.

PART 2 - PRODUCTS

2.1 The following transformers data sheets shall be submitted to the client for approval:

   A. Medium Voltage Transformers above 2400 volts.

   B. Low Voltage Transformers below 600 volts.

END OF SECTION 16461
SECTION 16470 – PANELBOARDS, DISTRIBUTION PANELS AND BRANCH PANELS

PART 1 - GENERAL

1.1 Distribution panels shall be of the bolt-on circuit breaker distribution type. Circuit breakers shall have manual quick-make and quick-break and automatic quick-break and thermal magnetic tripping. Breakers shall be 75 degree C rated.

1.2 Branch circuit lighting and motor panels shall be bolt-on circuit breaker type of the thermal magnetic type with manual quick-make and quick-break and automatic quick-break. Multiple pole breakers shall have a common trip.

1.3 All circuit breakers for the above mentioned panels shall bolt directly into the bus.

1.4 At least 20 percent of the total number of breakers in every branch circuit panel shall be spares.

1.5 Cabinets shall be equipped with doors that have keyed locks and flush handles. A typed circuit directory shall be provided in covered frame in each cabinet. Facilities Design & Construction shall approve directory before it is typed.

1.6 All panelboards rated 100 amps and larger shall have door-in-door front covers.

1.7 I-Line and Spectre type panel board will be accepted.

1.8 Powerlink lighting control panels shall be used for common spaces such as corridors, open study areas, etc. Theses panels shall be controlled by the BMS.

1.9 All panelboards shall comply with the requirements of Chapter 5, Division 16, Section 16195.

PART 2 - PRODUCTS

2.1 Generally accepted panelboard manufacturers are as follows. Shall be submitted to client for approval.

A. Distribution panels
   General Electric
   Westinghouse/Cutler Hammer
   ITE/Siemens
   Square D

B. Branch circuit panels
   General Electric
   Westinghouse/Cutler Hammer
   ITE/Siemens
   Square D

END OF SECTION 16470
SECTION 16476 - ENCLOSED CIRCUIT BREAKERS

PART 2 - PRODUCTS

2.1 Generally accepted equipment providers. Provide submittal for acceptance.

A. All circuit breakers datasheets shall be submitted to the client for approval:

1. Circuit Breakers
   - General Electric
   - Westinghouse/Cutler Hammer
   - ITE
   - Square D

END OF SECTION 16476
SECTION 16485 - CONTACTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Magnetic contactor for remote control of area lighting shall be mechanically held with coil clearing contacts of amperage rating required. Contactor shall be incorporated in panel by panel-board manufacturer. Contactors shall be controlled with momentary contact switches.

   1. Generally accepted equipment. Provide submittal for acceptance.

PART 2 - PRODUCTS

2.1 All magnetic contactors/starters datasheets shall be submitted to the client for approval:

   A. Magnetic contactors lighting and heating:

      1. ASCO - Bulletin 920
      2. ITE - Bulletin 920 - Siemens
      3. General Electric
      4. ABB/Westinghouse/Cutler Hammer
      5. Furnas
      6. Square D

   B. Magnetic motor starters

      1. General Electric
      2. ABB/Westinghouse/Cutler Hammer
      3. ITE - Siemens
      4. Furnas
      5. Square D

END OF SECTION 16485
SECTION 16496 - ENCLOSED TRANSFER SWITCH

PART 1 GENERAL

1.1 POWER

A. The design team will determine whether the facility will have emergency power transfer (life safety items only) or whether the facility will have stand-by power transfer (other than life safety) or both.

1.2 LIGHTING

A. The design team will determine whether the facility will have emergency lighting that will be switched.

1.3 GFCI MAINS

A. All buildings that are to be served by 3-phase GFCI Main Breakers, and equipped with generators for Emergency and Standby use shall have 4-Pole Overlapping Neutral (make before break type) Transfer Switches.

PART 2 - PRODUCTS

2.1 GENERAL ACCEPTABLE EQUIPMENT

A. Provide submittal for approval.

   1. All enclosed transfer switches datasheets shall be submitted to the client for approval.

B. Emergency/Stand-by Power Transfer Switches: Generally acceptable manufacturers.

   1. Onan
   2. Caterpillar
   3. Russelectric
   4. Generac
   5. ASCO/Emerson
   6. KOHLER

C. Emergency Lighting Transfer Switches: Generally acceptable manufacturers.

   1. Entertainment network:

      a. RHG-120
      b. RHG-277
      c. NINE 24, Inc.
d. BLTC-R-120  
e. BLTC-R-277  
f. BLTC-I-120  
g. BLTC-I-277

END OF SECTION 16496
SECTION 16510 - INTERIOR LUMINARIES

PART 1 – GENERAL

1.1 Summary

A. Related Requirements Specified Elsewhere:

1. Chapter 5, Division 16, Section 16010.

B. Normal Lighting: A building’s normal lighting system necessary to provide lighting for the intended occupation and use of the facility under normal operating conditions. Lighting levels are to be designed in accordance with the values recommended by the latest edition of the Illuminating Engineering Handbook.

C. Night Lighting: Lighting meant to remain on at all times to assure minimum illumination for security and other purposes. This lighting is generally along building circulation routes and may, for example, consist of a single, low wattage down light at each end of a corridor. This maximizes potential lighting energy and long range maintenance savings by allowing all other lighting to be turned off during unoccupied periods. Night lighting is NOT the same as emergency lighting or standby lighting. Powerlink lighting panels (Circuit control) and WattStopper OC sensor switches should be used in such a way to shut all/selected lighting circuits off after operating hours by the powerlink panel, but yet allow the OC sensors to override the panel and provide lighting as needed where the sensors are located. Lighting in stairs will be exempt, and shall remain ON 24/7. GTD (Generator Transfer Device) may be used as well.

D. Lighting design for new or renovated spaces shall meet the current New Hampshire Energy Code, and IECC 2006 or the latest edition.

E. Choice of fixtures should be made with the following considerations:

1. Energy efficiency and sound rating.
2. Quality of lighting.
3. Ease of installation and installation flexibility.
4. Ease of maintenance.
5. Suitability for the specific application.
6. Replacement parts availability.
7. Consideration of potential abuse.

F. Where partitions will result in uneven or substandard lighting (based upon Illuminating Engineering Society Recommended Lighting Levels), fixtures shall be relocated and/or additional fixtures shall be installed. The use of energy efficient fluorescent adjustable task lighting is encouraged in partitioned work stations.

G. Fixtures:

1. Interior Direct Luminaries
a. 2 x 4 recessed troffers with High Performance Low Wattage (HP) T-8’s, or T-5’s lamps shall be the standard for suspended ceiling and surface-mount applications. T-5 HO lamps shall be used in high bay applications only (too bright for low ceilings).
b. 2 x 2 recessed troffers or surface-mount fixtures with T-5 lamps shall be utilized in limited areas for specific applications. T-5 HO lamps shall be used in high bay applications only (too bright for low ceilings).
c. Parabolic lenses and/or direct/indirect fixtures either basket type or volumetric illumination shall be used in areas in which VDT’s dominate the activity. Where parabolic fixtures are selected cell number and size shall be selected for the specific application.
d. Lenses shall meet IES standard RP-1-04 glare control recommendations, for maximum allowable candlepower for VDT intensive and VDT normal use area.
e. Appropriate lenses shall be selected for each application in accordance with IES RP-1-04. Glare shall be a consideration in determining the quality of the light, and shall meet recommended IES standards for glare control for each space depending upon the use.
f. Fixtures shall be tandem-wired whenever possible to minimize energy consumption.

2. Indirect Luminaries

a. Shall be considered for areas which contain VDT’s or audio-visual equipment and have unobstructed reflective ceilings of appropriate height, and other appropriate areas.
b. Fixtures shall utilize Low Wattage HP T-8s, T-5 and T-5HO lamps.
c. Fixtures shall be tandem-wired whenever possible to minimize energy consumption. 3 and 4 lamp fixtures shall be tandem wired to inboard and outboard for lamp configuration. 2 Lamp fixtures shall be tandem wired to allow for each row within the fixture to be switched independently.

3. High Abuse Luminaries

a. High abuse luminaries shall be used in areas which are susceptible to acts of vandalism.
b. High abuse luminary lenses shall have a lifetime warranty.

4. Special Application

a. Including pendant-mount fixtures, accent light, wall sconces and fiber-optic systems shall use high-efficiency fixtures, and shall receive approval in writing from FD&C.
b. Heating Tunnel Fixtures.

5. Light fixtures in a suspended ceiling shall be supported from the building structure. Independent fixture support is required for life safety purposes in the event of ceiling grid failure.
6. Exit Signs: Edge lit or cast aluminum, green lettering, LED type, wall mounted exit signs shall be used whenever practical. See Chapter 5, Division 16, Section 16613 for exit signs and emergency egress lighting.

H. Lamps:

1. Fluorescent
   a. Straight fluorescent T-5’s and T-5 HOs shall be acceptable for new construction and new fixtures.
   b. Straight fluorescent (HP) T-8’s, T-5’s and T-5 HOs, shall be 3500K with a CRI greater than 85.
   c. Straight fluorescent (HP) T-8’s T-5’s and T-5 HOs shall be of low mercury content less than 5 mg of mercury per four foot lamp.
   d. Medium bipin U-bent fluorescent lamps are not acceptable for use in new construction.
   e. All Lamps shall be low mercury, and shall pass the EPAs Toxicity Characteristic Leaching Procedure (TCLP).

2. Compact Fluorescent
   a. Electronically ballasted, 4 pin, 3500K.
   b. Screw-in compact fluorescents, 3500K.
   c. PL triple four-pin fluorescent lamps other than 26W, 32W and 42W are to be utilized only in specific circumstances and with prior approval from FD&C.
   d. PL long fluorescent lamps, 18 to 50 watts are not acceptable for use in new construction.
   e. All CFL lamps shall be low mercury and shall pass the EPAs Toxicity Characteristic Leaching Procedure (TCLP).

3. Incandescent, halogen, and MH lamps are NOT acceptable, however they are to be used only with written permission from University Facilities Design and Construction (FD&C).

I. Ballasts:

1. Fluorescent Electronic Ballasts
   a. Straight Fluorescent Lamps, normal HP T-8’s, T-5’s and T-5 HOs
      1) Electronic ballasts shall be Program Start and provide for parallel wiring of lamps. Rapid Start Ballasts shall be used with permission in writing by FD & C and only in those applications where program start ballasts cannot be utilized.
      2) Ballast shall be program start normal HP T-8, T-5 and T05 HO.
      3) Total harmonic shall be 10% or less.
      4) Power factor shall be 95% and greater.
      5) Ballast shall have a sound rating of A.
      6) Ballasts shall be free of PCB’s.
      7) Warranty shall be for a period of five years.
2. Dimming Ballast Straight and Compact Fluorescent
   a. Shall dim from 100% to 5% of full lamp output for HP T-8’s, T-5’s, and 100% to 5% for linear fluorescent and compact fluorescent.
   b. Power factor shall be greater than 95%.
   c. Total harmonic distortion less than 10%.
   d. Sound rating A.
      a. Light level output shall be continuous, smooth and flicker-free over the entire dimming range.
      b. Warranty shall be for a period of five years.

3. HID Ballasts Pulse Start only Potted Core for interior applications,
   a. Linear Reactor: 277 Volt only
   b. Constant Wattage Auto transformation (CWA)
   c. Warranty two years or greater.

4. Electronic Ballasts-Cold Application to -20F
   b. Warranty shall be for a period of five years.

J. Switches:
   1. Individual wall-mounted switches shall be installed to control only the lighting within individual spaces. Pull chain fixtures shall not be installed.
   2. Switches shall be installed so that light fixtures along windows are controlled by a separate switch; Multi-level day-lighting control shall be provided whenever economically justified.

K. Occupancy Sensors:
   1. Occupancy sensors shall be wired to the line side of the lighting circuit.
   2. Classrooms and conference room spaces shall utilize Dual-Technology occupancy sensor(s).
   3. Bathrooms, Stairwells, Corridors and Open Office Spaces shall utilize ultrasonic occupancy sensor(s). Ultrasonic sensors shall not be used when ceiling heights exceed 12-14’.
   4. Ultrasonic Sensors shall be mounted at least 6-8’ away from any air supply registers.
   5. Perimeter Offices and Laboratories Shall Utilize Passive Infrared occupancy sensor(s).
   6. Special areas shall utilize technology per manufacturer’s recommendation.
   7. All occupancy sensors shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common Outputs for use with HVAC Control, Data Logging and other control options.
   8. Storage Closets, Equipment Rooms, Janitors Closets, Tel/Com, Electrical, and Mechanical Rooms shall utilize Digital Time Switch(s). Time switch shall be adjustable from 5 minutes to 12 Hour time period. Time switch shall utilize optional flash-warn and audible alert prior to timing out. Mechanical Room Time Switches shall be set for 8 hours for initial installations.
9. Bathrooms in residence halls shall have one fixture that remains ON.
10. All sensors shall have readily accessible, user adjustable settings for time-delay and sensitivity.
11. Sensors shall be installed in quantity and located properly per manufacturer’s recommendation to provide appropriate room coverage.
12. Unless Specified otherwise, the contractor shall set all time-delay settings to no-less than 15 (Fifteen Minutes).
13. Powerpacks shall utilize Zero-Crossing Circuitry to protect from the effects of inrush current and increase product longevity.
14. Occupancy Sensor layouts will be reviewed and approved by the manufacturer to ensure appropriate technology, location and number of sensors for each project.
15. Warranty shall be for a period of five years.

L. Daylight Harvesting Controls:

1. When installing open-loop daylight harvesting control systems, upon completion of the installation, the system shall be commissioned by a manufacturer’s authorized technician who will verify all adjustments and photocell placement to ensure a trouble-free operation of daylighting control system.
2. All photocells and daylight harvesting control products shall be installed in quantity and located properly per manufacturer’s recommendations, and reviewed in advance by the manufacture prior to installation.

M. Automatic Lighting Control Systems: When used in specific applications, shall comply with the following:

1. Microprocessor-based lighting control systems shall be compatible with the Andover Controls Building Automation System. A separate microprocessor-based control system for local lighting is not acceptable. Electrical engineers shall coordinate lighting controls with the DDC (Direct Digital Control) system specified by mechanical engineers for HVAC equipment within the occupied space.
2. Building Automation system control panels shall contain an LED pilot light and integral self-reporting, hand-off-auto override switch for each lighting output control point within the occupied space.

PART 2 – PRODUCTS

2.1 All below lighting fixtures and ballasts datasheets shall be submitted to the client for approval:

A. Fixtures, Acceptable Manufacturers:
   - Cooper
   - Kenall
   - Hubbell (Columbia and Prescolite)
   - Lithonia
   - Genlyte
   - Or Owner-approved equal.
   - SPI
   - Advent
   - Lite Control
   - Bega
   - Visa
   - Canlet (Heating Tunnel Application)
B. Fluorescent Straight & Compact Lamps, Acceptable Manufacturers: Low Mercury
   GE
   Osram/Sylvania
   Philips
   Or Owner-approved equal.

C. Metal Halide Pulse Start Lamps, Acceptable Manufacturers:
   GE
   Osram/Sylvania
   Philips
   Venture
   Or Owner-approved equal.

D. Fluorescent Electronic Ballasts, Acceptable Manufacturers: Program Start for all linear
   fluorescent with lamps wired in parallel, Electronic Non-Dimming:
   Advance
   GE
   Warranty shall be for a period of five years or Owner-approved equal.

E. Fluorescent Dimming Ballasts, Acceptable Manufacturers:
   Advance
   Lutron
   Sylvania
   Warranty shall be for a period of five years or Owner-approved equal.

F. HID Metal Halide Pulse Start Ballasts, Acceptable Manufacturers:
   Venture
   GE
   Osram/ Sylvania
   Advance
   Warranty two years or greater or Owner-approved equal.

G. Occupancy Sensors, Acceptable Manufacturers:
   Watt Stopper
   Warranty shall be for a period of five years or Owner-approved equal.

END OF SECTION 16510
LISTING 16530 - SITE LIGHTING

PART 1 - GENERAL

1.1 Design Philosophy: The University intends that outside lighting accomplish several critical functions. First, site lighting must adequately illuminate buildings, pedestrian walkways, roads and parking areas. This illumination enhances security, reduces the risk of accidents and improves the overall safety of the campus. Site lighting should also enhance way-finding by making walkways, building entrances and other key features easily visible. Finally, exterior lighting should add to the visual appeal of the campus and its buildings and grounds.

1.2 Illumination Levels: The University will provide lighting only on approved and maintained pedestrian walkways and paths. Unapproved footpaths that are not maintained will not be lit.

A. Section Includes:

1. For approved and maintained pedestrian walkways and paths, the minimum illumination level shall be .5 fc with a 4:1 illuminance uniformity ratio. DO NOT OVER ILLUMINATE.
2. Generally do not illuminate roadways, rather illuminate crosswalks and sidewalks. It is not necessary to achieve a standard along the center of the roadways, but crosswalks should be a minimum of .7 fc.
3. Achieve the necessary levels of illumination at the lowest reasonable levels of energy consumption
4. Strive for even levels of illumination along walkways, sidewalks, and parking lots. Center of roadways should have less illumination than the crosswalks. Varying levels of lighting along a pathway create areas that, while adequately lit, are perceived as being very dark by contrast with over-illuminated areas. In particular, fixtures that create glare by directing light into the eyes of pedestrians or drivers of vehicles are to be avoided.
5. Up-light pollution is generally not allowed with very limited exceptions. Full cutoff fixtures shall be used. Provide good color rendition.

1.3 Lighting Fixture Location:

A. Roadway Fixtures/Poles shall be located a minimum of (5') Five feet off the edge of pavement where ever possible.

B. Parking Lot Fixtures/Poles shall be located a minimum of (5') Five feet off the edge of the pavement where ever possible.

C. Walkways Fixtures/Poles, shall be located a minimum of (3') Feet off the edge of a paved walkway where ever possible.
PART 2 – PRODUCTS

2.1 Outdoor Fixtures: Cobra head fixtures are not allowed, flood lights should be avoided, but when there is no alternative, they must be shielded to comply with Dark Sky standards. If only one or a few new fixtures are being installed then the lamp type (metal halide or high pressure sodium) should be consistent with what most common in the area. If there is already a mixture or if many new fixtures are being installed then they should be metal halide.

A. Roadway, Parking Lot, Basketball/Volleyball Play Area Lighting; Metal Halide Light Fixtures.
   1. Kim Lighting, Archetype, AR, pulse start metal halide, round aluminum tapered 20 ft pole, bronze finish, 320-400 watts depending upon spacing and configuration
   2. Cooper Industries, Streetworks, Talon, TMU, pulse start metal halide, round aluminum tapered 20 ft pole, bronze finish, 320-400 watts depending upon spacing and configuration

B. Flood Lighting; Metal Halide Flood Light Fixtures.
   1. Cooper Lighting Streetworks, General Purpose Flood, pulse start metal halide, bronze finish, 350-750 watts depending upon spacing and configuration

C. Walkway Lighting; Metal Halide Walkway Light Fixtures.
   1. For Core Campus - Sternberg Cat. #1910/508/RLM18/4400/DDRT 4-3/12AG/ (wattage to be determined by layout and location, but often is 175MH) Multi Tap.
   2. For other areas of campus - Kim Lighting, Archetype, SAR, pulse start metal halide, round aluminum tapered 16 ft pole, bronze finish, 320-400 watts depending upon spacing and configuration

D. Walkway Lighting; High Pressure Sodium Walk Light Fixtures.(only as replacement for current fixture)
   1. Unique Solutions Cat. #RLPT-HP-MT-Bk-13R, 50, 70, or 100 watts depending upon spacing and configuration

E. Wall Lighting; Metal Halide dark sky approved down light fixtures with metal halide or fluorescent lamps. Fixture must be rugged and vandal resistant, but easy to change out lamps. Lamps must be a common and readily available type.
   1. Kenall Millenium Series - MH
   2. Stonco - Nytepro – MH
   3. AccuLite Polaris Series - MH

F. Fiberglass Walklight (only as replacement for current fixture) Whatley Round Tapered Cat. #E3118-10-52 – No Handhole.Steel tenon 3"OD x 3-1/2" long, 1-3/8" wire entrance hole, textured finish - color, black.
G. Pole Bases: Pole bases may be either pre-cast or cast in place concrete 24” diameter, set into the earth at least 60” and shall be no more than 6” above the finished grade on the high side of the slope, except when located in the paved area of a parking lot or driveway where it should be 36” above the finished pavement. The concrete base shall be round and shall have a 3/4” chamfer edge. Bolt pattern shall be as recommended by the pole manufactures. Grounding and conduit runs shall be provided in accordance with the current applicable codes, and shall be indicated on the project drawings.

H. Ballasts:
   a. Ballasts shall be multi tap for 120-208-240-277 volts and of non-PCB. Acceptable ballast manufacturers are:
      - Universal
      - Valmont
      - Advance
      - Jefferson
      - Venture Uni-Form Pulse Start (preferred)

I. Guideform Specs for Pulse Start Ballasts:
   The pulse start metal halide ballast shall be Venture product #_________ , ANSI type M-___. Circuit type shall be (Ignitor CWA; energy-saving 277V Reactor) with a maximum system input wattage of _______ and a current crest factor not to exceed 1.6 for Ignitor CWA; 1.5 for Reactor-ESB. All system components will be warranted for a period of two years from date of installation or four years when supplied as part of a registered system project, in accordance with the One Call Limited Warranty.

J. Lamps:
   a. Acceptable ballast manufacturers are:
      - General Electric
      - Osram/Sylvania
      - Philips
      - Venture Uni-Form Pulse Start (preferred)

2. Guideform Specs for Pulse Start Lamps:
   The pulse start metal halide lamp(s) shall be Venture, Uni-Form pulse start #_________ ANSI type M-___. If used in an open luminaire, the lamp must be rated Open Fixture (O) and incorporate a protective arc tube shroud. Performance shall be _______initial lumens with a _______% maintenance factor. The lamp carries a one year replacement warranty, or when operated with a Venture ballast, the limited warranty period is two years (assuming 5000 avg. burn hrs./year), when part of a registered system project, in accordance with the “One Call” Limited Warranty.
PART 3 - EXECUTION

3.1 Circuit design. If multiple fixtures are fed by a single circuit, a photocell will be provided on each fixture for control. If a Master Photo Control is used on the system a manual override shall be provided in the main electrical room for maintains/testing purposes, this over ride switch shall be identified with laminated Red-white phenolic plates engraved with a minimum of ¼" White letters stating manual override for walklight system. Dual 120 volt circuit design is preferred for walk light systems, place every other fixture on the opposite circuit, Under no circumstances will time clocks be used to control exterior light power systems.

3.2 The Sternberg fixture and pole indicated above shall be used on all new walkway and site lighting installations unless the designer is otherwise directed by the University.

3.3 Underground wiring of all walkway lighting shall be in a minimum of 1” PVC conduit buried according to NEC standards and to have a minimum conductor size of at least #10 wire, or larger if circuit line loss requires it.

3.4 Unique Solutions fixtures will be used for replacement of existing carriage lantern type fixtures when in areas that are not being converted to the Sternberg fixture. Whatley Round Tapered Fiberglass poles will be used with the Unique Solutions fixtures.

3.5 Wall Lighting in general, shall not be used on any new primary facilities construction/renovation unless directed otherwise by the Owner. If so directed Metal Halide fixtures shall be used.

3.6 In all cases, for underground wiring of parking lot lighting, no direct buried cable will be accepted as a method of wiring exterior lighting. At a minimum, PVC conduit of the required size with individual conductors shall be used.

END OF SECTION 16530
SECTION 16613 - EMERGENCY POWER SUPPLIED SYSTEMS

PART 1 – GENERAL

1.1 Related Requirements Specified Elsewhere:
A. Chapter 5, Division 16, Section 16010.

1.2 A separate and independent system of light fixtures outlets, conduit, wiring and distribution panels, etc., provided in all buildings for a 208Y/120 volt emergency system powered by generator or storage batteries.

1.3 The emergency system shall include:
A. Emergency Lighting for all corridor, hallway and stairway that is required by code to support the evacuation and egress of a building during an emergency which results in the loss of normal power shall comply with the following:
   1. Emergency lighting levels shall be sufficient to evacuate a building as required by code.
   2. Emergency lighting can be combined with normal lighting if one of the following methods is used.
      a. Bodine ballasts in fluorescent fixtures.
      b. UL Listed, NEC/NFPA Compliant, Emergency Lighting Switching Controller
      c. DC power systems, small and high capacity inverter systems in standard and fast transfer versions. Both single and 3 phase to be used independently or with controls to be used in conjunction with generator systems. These systems should be considered as a means of supplying stored emergency power to serve multiple lighting units or a whole floor or building from 1 source.
   3. Exit lights placed so that residents can be led to the most direct route to the exit.
   4. Green is the University’s preferred color as a standard for Exit signs.
   5. LED exit signs shall be illuminated by light emitting diodes and wired in parallel per UL 924 such that if one diode fails, the rest of the sign will stay lit. These units shall operate on power supplied form the emergency power system, Inverter, or batteries.
   6. Stencil type signs are permitted.
   7. Normal W.P. fixtures shall be used at each exterior egress door, and shall be powered from the life safety system (Inverter/E-Gen, or batteries).

B. Buildings that are not required to have an Emergency Power Supplied System shall be equipped with Inverter/battery powered exit signs and Inverter/battery powered emergency lighting as directed by the University.
PART 2 - PRODUCTS

2.1 All systems listed below shall be submitted to the client for review and approval.

2.2 Exit Signs:
   Hubbell/Dual Lite CSX Series
   Hubbell/Dual Lite LX Series
   Cooper Sure -Lites UX

2.3 Dorm High & other High Abuse Areas: Life Time warranty on lens and housing Kenall Series 6500 – LED Trailmate XMLB/METSU/METDU.

2.4 Emergency Lights: (where permitted by the Owner)
   A. Dorm Areas
      Hubbell/Dual-Lite AS Series
      Hubbell/Dual-Lite CVEC Series
      Cooper Sure-Lites XR Series
      Lithonia - Series C/M & TITAN
      Kenall - Exilume Series
   B. Academic Areas Only
      Hubbell/Dual-Lite CV Series
      Hubbell/Dual-Lite AS Series
      Hubbell/Dual-Lite LZ Series
      Cooper Sure-Lites CC2 & CC8 Series
      Cooper Sure-Lites LPX(H) Series
      Lithonia - Series ELU-C/CM or TITAN
   C. High corrosion area outdoors
      Hubbell/Dual-Lite NEMA 4 X Series
   D. High corrosion area indoors
      Hubbell/Dual-Lite LM Series
   E. Batteries to be - Maintenance-free Lead Calcium.

2.5 Combination Exit/Emergency Light/Sign
   Hubbell/Dual-Lite CVT Series
   Hubbell/Dual-Lite LT Series

2.6 Fluorescent Emergency Ballast: Bodine – B50
   A. For existing fluorescent light fixtures:
      1. Care shall be taken to make sure that these units are wired according to the manufacturer’s recommendations. Self testing and diagnostics and status
2.7 Inverters, provide submittals for approval.

2.8 Emergency Lighting Transfer Switching Controller:

A. As of this 03-03 revision these units are UL Listed and approved for use by the State Electrical Inspector on the University Durham Campus. See Exhibit #1.

1. Entertainment networks
   a. RHG-120
   b. RHG-277

2. NINE 24, Inc.
   a. BLTC-R-120
   b. BLTC-R-277
   c. BLTC-I-120
   d. BLTC-I-277
EMERGENCY LIGHTING SWITCHING CONTROLLER WIRING DIAGRAM

NORMAL POWER

2CR

N.O.
WALL SWITCH
EMERGENCY POWER

WALL SWITCH
NORMAL POWER

NORMAL LAMP BALLAST

EMERGENCY LAMP BALLAST

NORMAL LAMP BALLAST

EMERGENCY LAMP BALLAST

TYPICAL FOR EACH FIXTURE WITH EMERGENCY AND NORMAL LAMPS

GENERAL NOTES

1. THIS WIRING DIAGRAM IS GENERIC AND SHOULD BE USED FOR GENERAL INFORMATION ONLY. CR1 IS A DOUBLE POLE RELAY WITH N.O. AND N.C. CONTACTS TO PREVENT A CROSS CONNECTION BETWEEN NORMAL POWER AND EMERGENCY POWER.

2. ALL CONTROLLERS USED IN THIS APPLICATION SHALL BE UL LISTED AND COMPLY WITH NEC ARTICLE 700 EMERGENCY SYSTEMS AND NFPA 101 SECTION 5-8.

3. ALL LISTED CONTROLLERS SHALL BE WIRED PER MANUFACTURERS RECOMMENDATIONS AND IN COMPLIANCE WITH THE MOST CURRENT NEC.

END OF SECTION 16613
PART 1 – GENERAL

1.1 Emergency generator required in all newly constructed residence, dining halls, health facilities and buildings with special needs.

1.2 Emergency generator fuel will be chosen depending on what type is available at the generator locations. Diesel, Natural Gas, Propane. Gasoline is only used on portable units.

PART 2 - PRODUCTS

2.1 System shop drawings and datasheets shall be submitted to the client for approval:

A. Packaged engine generator system:
   Onan
   Caterpillar
   Generac
   KOHLER

END OF SECTION 16620
SECTION 16670 – LIGHTNING PROTECTION

1.1 All buildings shall be surveyed for need for lightning protection, and where necessary shall be protected.

1.2 Where lightning protection is specified, all materials and equipment and the arrangement of the system must be in compliance with the manufacturer’s "Installation Requirements" for “Early Streamer Emission Lightning Protection System.”

1.3 The following items of work are specifically included in, but not necessarily limited to, the work of this system:
   A. ESE lightning protection air terminal
   B. Mast, complete with base and supports
   C. Down conductors
   D. Ground ring
   E. Conductors
   F. Transient Voltage Surge Suppression

1.4 All buildings of steel construction shall have all steel adequately bonded together and grounded.

1.5 All steel fences shall be grounded. Long fences shall be grounded every 100 yards and be physically separated every 400 yards with at least a 1-1/2 inch gap between metal parts. Fence grounds shall not be installed at gaps.

END OF SECTION 16670
SECTION 16721 FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The general provisions of the contract including General and Special Conditions and General Requirements shall apply to all work under this Section.

1.2 DEFINITIONS

A. Owner - The University of New Hampshire

B. Authority Having Jurisdiction (AHJ) - For buildings and facilities owned by the University, the AHJ is the Office of the State Fire Marshal (SFMO). Authority is typically delegated to the Durham Fire Department (DFD) for progress inspections and witnessing of system tests.

C. Contractor - In the context of this specification section, the contractor is a generic term referring to those responsible for the work including, but not limited to, the general contractor, electrical contractor, fire alarm installer, etc.

D. Fire Alarm Installer - Firm licensed, and firm’s personnel trained, by the fire alarm system manufacturer to sell and install their systems. At a minimum, the Fire Alarm Installer shall:

1. Provide all fire alarm equipment and devices.
2. Perform all programming and troubleshooting of the fire alarm system.
3. Perform all testing of the fire alarm system and components. Prepare and submit associated NFPA Testing & Inspections and Project Completion reports.
4. Provide first response to trouble signals during warranty period.

1.3 DESCRIPTION OF WORK

A. The work includes providing all labor, materials, equipment, accessories, services and tests necessary to complete and make ready for operation by the Owner a fire alarm system. Perform an acceptance test and make adjustments as required by the authorities having jurisdiction.

B. Provide as shown on drawings a complete fire alarm system, consisting of the following:

1. A fire alarm control panel with microprocessor based electronics, power supplies, amplifiers and batteries.
3. Audible and visual notification appliances.
4. Control outputs to ventilation systems.
5. Raceways, wiring and accessories as shown on the drawings and as required for a complete and operable system.
6. A voice evacuation system to function as an integrated fire detection and alarm signaling system.

C. Provide the following additional work where shown on the drawings:

1. Status monitoring of fire suppression systems.
2. Emergency voice/alarm communications
3. Smoke and heat detectors that initiate an elevator recall.

D. The following work is not included unless shown otherwise:

1. Fire suppression, except that wiring in switches is included and emergency generator systems.

E. The Contractor shall prepare all required drawings, wiring and riser diagrams, and make necessary submissions and obtain all approvals as required by The New Hampshire Fire Marshal’s Office (SFMO), and the Durham Fire Department (DFD).

F. All work shall be performed by qualified personnel, with all necessary licenses as required by the local agency having jurisdiction.

G. All equipment, components and assemblies shall be listed by Underwriters Laboratories, Factory Mutual or other recognized third party listing agency.

H. The exact location of all equipment shall be coordinated with existing equipment, HVAC ducts, etc.

I. Under no circumstances shall the input power to the control panel (120 VAC) or auxiliary 24 VDC power from the power supply of the panel be utilized for auxiliary external control functions (e.g. Fusible links, damper, etc.).

J. All initiating and indicating circuits are polarized and supervised. Polarity must be observed and no parallel-branching (tee-tapping) will be permitted.

1.4 RELATED WORK IN OTHER SECTIONS

A. University Construction Standards; including but not limited to Chapter 5, Division 16.

1.5 STANDARDS

A. The system shall conform to the following latest National Fire Protection Standards, and shall be installed as per all local and state building and life safety codes.

B. The “Durham Fire Department Specifications for the Installation and Maintenance of Fire Protection Systems Fire Hydrants and Fire Lanes” date January 2001, apply to and is an integral part of all work covered under this specification. The Durham Fire Department Specification must be satisfied. Any question must be addressed to the design professional for clarification.
C. Accessory components as required shall be catalogued by the manufacturer and UL listed to operate with the manufacturer's control panel.

D. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions, recommendations and requirements of the following:

6. Underwriters Laboratories.
10. NFPA 71 Central Station Signaling Systems.
12. NFPA 90A Installation of Air Conditioning and Ventilating systems.

1.6 SUBMITTALS

A. All submittals shall be electronic. No paper submittals shall be accepted. Reviewing party shall provide electronic review of submittals.

B. All submittals shall include a cover letter/transmittal sheet noting the date of submittal, information contained in submittal and any deviations drawings or specifications.

C. Minimum submittal requirements:

1. Plans for proposed fire detection and alarm systems shall be submitted to University and design professional least 15 days prior to any work being performed. The submittal shall include:

   a. Detailed floor plan to scale showing:

      (1) Code Summary to include code editions used and relevant exceptions cited.
      (2) Connected and non-connected detection devices.
      (3) Evacuation signals, including visual and audible ratings with riser diagram showing wattage tap and candela rating.
      (4) Main control panel location.
      (5) Remote annunciator location.
      (6) Location of outside A/V signal(s) with riser diagram showing wattage tap and candela rating.
      (7) The proposed Use of the building.
      (8) Anticipated ambient noise levels.
      (9) Type of construction.
(10) Unique or unusual features (ceiling pockets, sloped or multi-leveled ceilings, atria etc.).
(11) Location of HVAC units and associated air flow volumes.
(12) Location of the key box(es).
(13) 100% completion date.

b. A riser diagram of the complete fire alarm system including water flow, tamper, and any connections to other fire protection systems. Riser diagram shall include wattage taps and candela ratings for all notification devices.
c. Associated battery calculations showing the adequacy of the batteries with respect to system powering. System shall include a 20% factor of safety.
d. An annunciator detail drawing showing proposed labeling. Devices are not to be solely numbered, but are to be labeled on plan in English depicting location (i.e. Second floor west wing).

2. Detailed component and equipment list with model and Manufacturer's part numbers, and product sheets for each item of equipment.
3. A set of plans indicating University approval shall be available at the job site until after completion of the required acceptance test.
4. Any changes from the originally proposed or approved plans that should occur during construction will be documented by a written revision and be approved by the NHSFMO.
5. Additions or modifications of existing systems shall require a new approval.
6. Plans showing actual “As Built” shall be submitted after completion and acceptance of the system. These plans shall become the record of the University.
7. The University shall review and approve or disapprove all submittals within thirty days of date of submittal.
8. Submit the following to the University prior to ordering equipment:
a. Wiring diagrams showing connections between all system components.
b. Description of system operation.
c. Annunciator schedule showing titles for each fire alarm and supervisory zone and/or device.
d. Manufacturer's installation instructions, operations and maintenance instructions.
e. A complete layout of the entire system including conduit routing, conduit sizes, wire sizes and types.
f. Confirmation of the University color code schedule for wiring.
g. Battery sizing calculations indicating circuit loading and power supply loading. Voltage drop calculations shall be submitted for all notification appliance circuits exceeding 1.5 Amps or 300 feet in length.
h. Submittals shall be as a complete set. Partial submittal will not be acceptable.
i. Drawings shall not be on less than 22 x 34 inch sheets and shall identify all symbols used.
j. Submittals shall comprise:

(1) Detailed component and equipment lists with model numbers.
(2) Manufacturer's specification sheets for each item of equipment.
(3) Description of how specified system functions.
(4) Confirmation that manufacturer's representative will provide jobsite supervision during installation, perform final testing, and instruct operating personnel on system operation.

(5) Standby battery calculations showing all system components and the adequacy of their capacity with respect to system powering. Calculations shall be provided with the plan submittal. Component (including amplifiers) power requirements and formulas used to compute 60-hour required standby power plus 15 minutes of alarm at the end of this period. Notification appliance circuit load calculations shall be by speaker and strobe circuits. Indicate formula and basis used for worst possible case.

(6) Detailed wiring diagrams of specified system and all interconnection wiring. Wiring diagrams shall include total risers, terminal-to-terminal, exact color-coding, location, and function of each device. Drawing indicating one-line diagrams or typical wiring diagrams will not be accepted.

(7) Manufacturer's original catalog data and descriptive information shall be supplied for all major components of the equipment to be supplied. Supplier's qualifications shall indicate years in business, service policies, warranty definitions, and a list of similar installations.

(8) Contractor's qualifications shall indicate years in business and prior experience with installations that include the type of equipment that is to be supplied. All pertinent information shall be furnished regarding the reliability and operation of the equipment to be supplied. Delivery dates of the equipment to be supplied shall be furnished.

(9) Sufficient information shall be furnished so that the exact function of each installed device is known.

k. Submittals shall include proposed annunciating language of each device for review and approval by UNH and Durham Fire Department (DFD). An editable electronic copy shall also be provided upon request for University modifications.

l. Submittal of shop drawings shall contain at least one (1) set of original manufacturer's specification and installation instruction sheets. Subsequent sets may be copied. All equipment and devices on the shop drawings to be furnished under this contract shall be clearly marked in the specification sheets.

m. Supply documentation from the manufacturer that University personnel, to be identified by Project Manager will be allowed to attend a factory certification school on servicing and programming the system prior to its acceptance. Documentation shall also indicate whether the system programming software is included in the installed price. One (1) University representative shall become factory certified.

n. Available pre-recorded messages shall be submitted to University and DFD for selection/approval.

D. Submit prior to final acceptance testing.

1. Contractor shall submit, upon completion of system verification, an NFPA Testing and Inspections form providing a point-by-point check list indicating the date and
time of each item inspected and a Record of Completion confirming that the inspection has been completed and the system is installed and functioning in accordance with the specifications.

1.7 PERMITS

A. The installing contractor must secure a permit from the Durham Fire Department before working on the fire alarm or suppression systems. This permit indicates the plans for such system have been reviewed and approved by the fire department.

B. Anyone performing maintenance or testing on any fire protection system must secure a permit from the fire department before starting any work on the system. Any additions or modifications to an existing system will require a new permit.

C. This permit is in addition to any required mechanical, plumbing, or electrical permit required by the Town of Durham or State of New Hampshire.

D. Prior to conducting any work that has any chance of transmitting a trouble of fire alarm signal, the Durham-UNH Communications Center shall be notified (862-1392). Only those persons listed on the permit, and who can provide the proper permit number, shall operate system controls.

E. Permit numbers are to be kept confidential and not broadcasted via 2-way radio.

F. During periods of system shut down, the permit holder is responsible for occupant and fire department notification, should an emergency arise. Unexplained system activations are to be investigated.

G. Systems shall not be shut down overnight. The fire department should be notified anytime that a fire protection system is left out of service.

H. The permit holder is responsible for restoring the system prior to leaving the building. The permit holder shall verify with the dispatch center the alarm condition, and explain if the system is left in trouble.

I. The permit holders are responsible for system security. Control panels or other equipment are not to be left unlocked, nor are keys or codes to be left in the panel or control box.

1.8 RECORD DOCUMENTS, OPERATIONS AND MAINTENANCE MANUALS

A. Complete record documents before scheduling acceptance test. Record documents shall include all information required by the above SUBMITTALS section.

1.9 GUARANTEE

A. The contractor shall warranty all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance. The contractor shall provide a phone number answered 24 hours per day, 7 days per week,
and also a phone number for a replacement part source answered 24 hours per day, 7
days per week. During the warranty period, the installing contractor shall provide first
response to trouble signals that report into UNH Dispatch, and determine cause and
take corrective action that does not void the warranty, or necessitate the University
maintenance service contractor to assume responsibility for malfunctioning systems.

1.10 PHASE SEQUENCING

A. The Contractor shall perform construction in phases sequenced as described below.
The Contractor shall provide dates for completion of each work phase.

1. Phase 1
   a. Verify fire alarm system devices.
   b. Submit shop drawings for approval.
   c. Order all components.
   d. Commence installation of raceways and wiring.

2. Phase 2
   a. Install the new fire alarm system without any modification to the existing
      system. All work concerning the active portions of the fire alarm system
      shall be coordinated with the Owner to prevent false alarms and avoid
      unnecessary loss of protection.
   b. Post a temporary plastic laminated sign ("Out of Service" – final wording to
      be approved by Owner) on any new or existing pull station during such
      times that it is installed but not in service. These signs shall be provided
      and maintained by the Contractor.
   c. Perform acceptance testing.

3. Phase 3
   a. Transfer operation from the existing fire alarm system to the new fire alarm
      system, to be coordinated with Owner and the Durham Fire Department.
      The existing fire alarm system shall remain in operation until installation and
      testing of the new fire alarm system are complete.
   b. Ensure continuous alarm protection.
   c. If interruption of the existing fire alarm system is required, the Contractor
      must first obtain written permission from the Owner not less than 5
      business days prior to such interruptions. The Owner shall coordinate with
      the Durham Fire Department and with maintenance subcontract personnel.
   d. When requesting permission to interrupt service, the Contractor shall
      specifically state the work to be performed, together with the exact time and
      length of service interruption. Separate permission shall be requested for
      each interruption.

4. Phase 4
   a. Disconnect and remove the existing fire alarm control panel, peripheral
      devices, and all associated wiring and raceways without disrupting the
      operation of the new fire alarm system.
b. Electrically disconnect equipment and all associated wiring and raceways to be removed at the point of power source.

c. Where building systems or circuits are interrupted because of the demolition work, they shall be rerouted or relocated, modified and reconnected to provide a continuous system.

d. Where abandoned conduits are embedded in the structure, cap existing empty conduits, provide blank cover plates and plug open knockouts in existing electrical equipment.

e. Include as part of the scope of work all cutting, patching, finishing, etc., for removed and relocated electrical equipment. All holes and damage caused by the demolition work shall be properly patched with suitable materials to match existing surfaces.

f. All materials, equipment and debris resulting from demolition shall become the property of the Contractor and shall be removed from the site and disposed of properly by the Contractor.

B. The Contractor may submit alternate approaches and phasing. Alternate deduct(s) to reuse existing conduit or wiring, while minimizing the time frame of potential nuisance alarms, may be considered by the Owner if the risks are manageable.

1. The Contractor shall specify work periods for work concerning the active portions of the fire alarm system, during which nuisance alarms may occur.
2. The fire alarm system or portions thereof may not be inoperative for extended periods of time.
3. If interruption of the existing fire alarm system is required, the Contractor must first obtain written permission from the Owner not less than 5 business days prior to such interruptions. The Owner shall coordinate with the local authority having jurisdiction and with maintenance subcontract personnel.
4. In all cases where existing branch circuit conduit and wiring is to be re-used within the remodeled area, the Contractor shall test for grounding continuity and shall test the existing branch circuit wiring as though new, in accordance with the testing procedures outlined elsewhere in these Specifications.

PART 2 - PRODUCTS

2.1 BASE BID MANUFACTURERS

A. Equipment shall be Notifier, with the exception of manual pull stations and combination smoke / CO alarms. No substitutions will be considered (ref. UNH Purchasing & Contract Services SAMS#5787-0001). All devices shall be compatible with Notifier fire alarm panels.

2.2 SYSTEM DESCRIPTION

A. Furnish and install a completely functional addressable Digital voice evacuation fire alarm system with all initiating and indicating appliances, modules and circuitry. The system shall consist of, but not be limited to, the following:
1. Voice evacuation shall utilize new speakers or speaker/strobes to provide a slow-whoop tone signal followed by a pre-recorded general alarm message per local requirements, followed by the same slow-whoop tone. Subsequent zone alarm(s) shall cause resounding of the slow whoop signal.

2. ADA compliant strobe visual devices to flash at 120 flashes/minute, synchronized.

3. Addressable dual action pull stations, smoke detectors and heat detectors.

4. Duct detectors with addressable adapter modules. Duct smoke detectors shall send the fire alarm system into alarm, and shut down the associated equipment.

5. Tamper switches, flow switches and pressure switches with addressable modules.

6. Remote Test and Indicating Stations:
   a. Alarm initiating devices located in concealed areas shall have remote indicating stations in locations approved by the AHJ (authority having jurisdiction).
   b. Duct smoke detector(s) shall have remote indication and testing station(s) in location(s) approved by the Durham Fire Department.

2.3 SYSTEM OPERATION

A. Multiprocessor-Based

1. The system shall be of multiprocessor design to allow each I/O functional module to hold and execute its own microprocessor and software program under the control of the main system microprocessor. A common RS-485 style communications network shall tie all I/O functional modules in an integrated Internet work affording true "Distributed Processing" of all system operations. Each network-interconnected module shall have its own processor and memory.

B. Degrade Mode

1. The system shall have two modes of degrade operation to assure reliable system operation under the most adverse conditions. This extra degree of survivability is accomplished as follows:
   a. In the event of a failure of the main system microprocessor, each subordinate processor shall be capable of operating a general alarm program.
   b. In the event of multiple failures, the system shall automatically revert to ADAC (Auxiliary Degrade Alarm Mode), which will operate the system in a general alarm configuration. Activation of any conventional, non-addressable initiating device will automatically operate all notification devices in a non-coded pattern and shall activate the city connection to notify the Fire Department.

C. Field Programmable

1. The system shall be field programmable in two modes:
   a. Front panel programmed through the use of the on-board 2-digit display, and the use of the programming switches on the System Control Unit, and
the individual input and output circuits including zones, notification appliance circuits, and relays. While in the programming mode, the control panel shall provide fire alarms override to assure that no alarms will be missed or lost. Systems that must come “off-line” to be programmed will not be accepted. Programming shall be password protected and shall not require the use of an additional programming appliance or tool.

b. Computer programmed through the use of an FCP (Field Configuration Program) dedicated software package. The system configuration shall be saved to CD, and stored in the control panel for easy access and field program modification, without the addition of programming hardware. While in the programming mode, the control panel shall provide fire alarms override to assure that no alarms will be missed or lost. Systems that must come “off-line” to be programmed will not be accepted. A "hard" copy of the final system configuration showing all inputs, outputs, descriptions, addresses, programming matrices, etc., and a copy of the software for programming the panel shall be furnished at no extra cost.

D. Comparison Of Updated Programming

1. The field programming configuration program shall contain as an integral part, a UL recognized program that shall create an audit trail of changes made to the system configuration in the form of ASCII files, which can be reviewed, printed and/or archived, using commonly available text and file utilities. This program shall actually compare the updated file that is about to be downloaded with the system configuration that is actually in the control panel. Programs that simply compare old and new files resident in a computer shall not be acceptable.

2. Upon completion of the system configuration comparison and download, a file shall be created in the sub-directory containing the field configuration software. This file shall contain detailed information on the system configuration changes being made to the configuration currently residing in the control unit, and shall include identification of the following changes such as:

a. System Data

(1) System battery type.
(2) Notification Appliance circuit output coding pattern.
(3) Notification Appliance circuit silence inhibit time.
(4) Walk test timeout.
(5) System ID description label.
(6) Keyboard Display Unit access codes.
(7) Number of signaling line circuits (addressable loops) in the system.
(8) System class.
(9) Service reminder dates.
(10) Day operation start/end times.
(11) Weekend definitions.

b. Inputs

(1) Addition or deletion of both sensor and monitor points.
(2) Point type.
(3) Location.
(4) Verification.
FIRE ALARM SYSTEM

E. Control-By-Event (CBE) Program

1. Operation of a manual station or automatic activation of any smoke detector, heat detector, or water flow zone shall activate the system control-by-event program to cause:
   a. All notification appliances to sound in a temporal pattern and lamps to flash.
   b. Shut down all air-handling units as shown on plans.
   c. The "SYSTEM ALARM" red LED shall also flash and the panel audible sounder shall pulse rapidly.
   d. Indicate on the Keyboard Display Unit (KDU) the description of the specific digital addressable device in alarm via an 80-character alphanumeric display. The "SYSTEM ALARM" LED shall also flash and the SCU audible sounder shall pulse. The displays shall be of the liquid crystal type (LCD), clearly visible in poor light conditions.
   e. Close all magnetically held doors automatically.
   f. Perform any additional function, as specified herein or as shown on the plans.
   g. Notify the UNH Dispatch.

F. General System Operation

1. When an alarm occurs on a zone, the control panel indicates the alarm condition until manually reset.
2. An alarm may be acknowledged by pressing the "ACKNOWLEDGE" button. This shall silence the panel sounder, and change the "SYSTEM ALARM" LED and the individual zone LED, from flashing to steadily lit.
3. Audible notification appliances (except exterior audible appliances) may be silenced by pressing the "SILENCE" button. This shall steadily light the "SIGNAL SILENCE" LED. If a subsequent alarm is activated, the notification appliances shall "resound" until again silenced. Once silenced, audible notification appliances may be restored again by pressing the "SILENCE" buttons. Water flow zones shall be silenceable. Exterior audible appliances shall be non-silenceable. All visual notification appliances (interior and exterior) shall be non-silenceable. All visual notification appliances shall remain activated until the system is reset.
4. If the microprocessor fails, the system shall execute a default signaling program. This program will enable the panel to sound the audible signals and notify the UNH Dispatch. In addition, a yellow "DEGRADE" LED shall light to indicate the programming failure. Inability of the system to sound signals, or notify the fire department during microprocessor failure, shall not be acceptable.
G. Green "Power ON" LED

1. A green "POWER ON" LED shall normally be lit, indicating that the system is receiving normal AC electrical power. A failure of normal control panel power shall cause this LED to extinguish. The system shall operate on 120 or 240 V AC input power without modification or special components.

H. Yellow "System Trouble" LED

1. A yellow "SYSTEM TROUBLE" LED shall light and the system audible sounder shall steadily sound when any trouble is detected in the system. Failure of normal power, opens or short circuits on the notification appliance or zone circuits, disarrangement in system wiring, failure of the microprocessor or any identification module, or system ground faults shall activate this trouble circuit.
2. This shall silence the panel trouble buzzer. If additional trouble conditions occur, the trouble circuitry shall resound. The "ACKNOWLEDGE" switch shall acknowledge up to ten (10) trouble signals per switch operation.
3. During an alarm condition, all trouble signals shall be suppressed with the exception of lighting the yellow "COMMON TROUBLE" LED steadily.

I. Alarm Verification

1. Smoke detector alarm verification shall be a standard option on all zones while identifying any dry contact device (i.e., manual stations, heat detectors, etc.) as an immediate alarm. This feature shall allow those smoke detectors, that are installed in environments prone to nuisance or unwanted alarms, to operate with the following sequence:
   a. System Ready - prior to smoke detector alarm.
   b. Smoke Detector Alarm - @ time = 0.
   c. Pre-Alarm Window – 15 seconds; a distinctive pre-alarm indication shall be displayed.
   d. Zone Reset - 5 seconds (occurs at end of pre-alarm window).
   e. Alarm Verification Window - 30 seconds; the system shall respond to a second alarm from the same smoke detector zone as a system alarm.
   f. System Ready - no alarm verification.
2. NOTE: The verification sequence is suspended once a system alarm is activated.
3. When the system is in verification, there shall be no indication on the panel or at dispatch.

J. Alarm Signals

1. All alarm signals shall be automatically latched or "locked in" at the control panel until the operated device is returned to its normal condition, and the control panel is manually reset. When used for water flow, the SILENCE switch shall be bypassed.

K. Electrically Supervised

1. Each initiating and notification appliance circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring.
2. The occurrence of any fault shall activate the system trouble circuitry, but shall not interfere with the proper operation of any circuit that does not have a fault condition.

3. Each initiating circuit shall be capable of being wired using Class A, Style 7 supervised circuits (a ground fault on either conductor, or a break shall not prevent a device from operating on either side of the break) at no extra cost.

L. Drift Compensation - Analog Smoke Sensors

1. System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to the effects of component aging or environment (i.e., dust). Each smoke sensor shall maintain its actual sensitivity under adverse conditions to respond to actual alarm conditions while ignoring the factors that generally contribute to nuisance alarms.

2. The system trouble circuitry shall activate, display "DIRTY DETECTOR" and "VERY DIRTY DETECTOR" indications, and identify the individual sensor when a smoke sensor has been compensated beyond its acceptable limits, and transmit a trouble signal to campus dispatch.

M. Analog Smoke Sensor Test

1. System software shall automatically test each analog smoke sensor a minimum of three times each day. The test shall be a recognized functional test of each ionization chamber (Analog Ionization Sensors) and photoelectric (Analog Photo Electronic Sensors) as required annually by NFPA 72. Failure of an analog smoke sensor shall activate the system trouble circuitry, display a "Test Failed" indication, and identify the individual sensor.

N. Dual Mode Walk Test

1. The control unit shall provide a Dual-Mode Zoned Walk Test Program, which shall enable a single individual to test the Alarm/Supervision status of each initiating device connected to the system. During walk test, the control unit shall automatically reset after an alarm condition enabling the testing technician to continue testing the system without requiring a return to the control panel. The system shall allow the technician to disable certain actions such as elevator recall, mechanical unit shutdown, and security interface.

   a. During an Audible walk test, the act of placing a device in alarm will cause four pulses on the notification appliance circuits. Operation of a supervisory switch will cause three pulses, while removal or disconnection on an initiating device will cause two pulses on the notification appliance circuits. All tests will be recorded by a printer for historical reference.

   b. A Silent walk test will record all tests by a printer for historical reference while not activating the notification appliance circuits.

O. Printed Circuit Boards, Control Panel Components

1. All control units shall be contained in a 16-gauge steel cabinet.

2. All groups of circuits or common equipment shall be clearly marked and shall be expandable by inserting interchangeable units.

3. The control unit shall be red in color and shall include the following features:
a. Auxiliary SPDT alarm and trouble dry contacts.
b. Auxiliary circuitry in the control panel to operate remote relays for control of air handling equipment.
c. Sixty (60) hours of battery standby (as required per NFPA 72) using rechargeable batteries with automatic charger, to maintain standby batteries in a fully charged condition.
d. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting normal microprocessor operation and minimize resultant nuisance troubles and/or alarms. This circuit shall be physically isolated from the power supply to facilitate service. The system shall automatically transfer back to AC power when available and battery back-up system shall recharge.
e. A ground fault detector to detect positive or negative grounds on the initiating circuits, notification appliance circuits, power circuits, and telephone line circuit. A ground fault LED shall light, and the general trouble devices shall operate as specified herein, but shall not cause an alarm sound. Ground detection shall detect any condition 10k ohms or greater.
f. Short circuit LEDs for all notification appliance circuits shall be a standard feature of the fire alarm control panel. Each circuit shall be monitored for short circuits and shall have a distinctive LED for visual indication of the circuit and operating trouble devices as specified herein, but shall not cause an alarm to sound.
g. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, notification appliance circuits, and telephone line circuit. Systems that require an optional module to provide this protection shall not be considered equal.
h. Individual circuit fuses shall be provided for the following: smoke detector (resettable) power, main power supply, battery standby power, and auxiliary (non-resettable) output.
i. A common reset and lamp test switch, labeled "RESET/LAMP TEST" shall be provided to reset the Series control panel.

P. Campus Connection

1. The fire alarm system shall be connected to the UNH dispatch center via supervised reverse polarity remote station connection. The connection shall be self-restoring upon return of telecommunications lines after outages.

Q. Multiplex Configuration

1. The system shall be designed to accommodate module placement at either central location, or from one to fifteen remote locations. System integration shall utilize the RS485 style multiplex communications with a true "Distributed Processing" of system intelligence.
a. The system shall be able to maintain both degrade modes to assure maximum survivability of the system in the event of either, the loss of system communications, or failure of any or all microprocessors.

2. Provision shall be made to accommodate coding at all remote panels, to be synchronized to the coding patterns generated at the central control panel, to assure proper phasing of alarm signals.

2.4 SYSTEM COMPONENTS

A. General System

1. The analog/multiplex system shall consist of, but not be limited to the following units, components, and peripheral devices, each of which is described in detail in this section.

B. System Cabinet

1. Except as otherwise approved by Owner, the system cabinet shall be semi-flush mounted with a red or black finish, at Owner’s option, and shall consist of backbox, backplate, trim ring, dress panels, battery panels and door. The system cabinet houses the microprocessor and related system circuitry modules. The cabinet shall be labeled with the manufacturer’s name and logotype to assure the integrity of the complete system.

2. The cabinet shall be of dead-front construction and 16-gauge cold rolled steel. The door lock system shall consist of two locks, which will each accept the same key. One CAT-30 Operative "OPER" key shall allow dead front access to the module displays for all operator functions, and shall also allow access to all control panel electronics, without further dismantling of the cabinet, control unit, or wiring.

3. The system components shall be installed on a hinged mounting plate which may be removed to facilitate easy installation and testing of field wiring. A minimum of a 1-inch wiring gutter space shall be provided behind the mounting plate to protect the system electronics at completion of the installation. Wiring shall be terminated on removable terminal blocks to allow field servicing of all modules without disrupting system wiring.

C. Main Fire Alarm Control Panel

1. The FACP shall be completely microprocessor based.

2. Basic System Operator Controls:

   a. Acknowledge Switch: Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON.

   b. Alarm Silence Switch: Activation of the alarm silence switch shall cause all programmed devices to return to the normal condition after an alarm.

   c. System Reset Switch: Activation of the System Reset switch shall cause all devices and circuits, to return to their normal condition.
d. Lamp Test: The Lamp Test switch shall activate all system LEDs and light each segment of the liquid crystal display.

D. AC Unit (ACU)

1. All AC line connections shall be isolated from the power supply unit and circuitry for all system power supplies to meet U.L. Standard 864 for "brown-out" operation. The ACU shall operate from either 120 or 240 VAC as a standard feature.

2. Loss of AC power trouble signal shall be programmable with a variable (adjustable) delay preventing trouble signals upon minor power sags. All remote stations shall be neatly and permanently labeled, as to the particular device it serves.

E. Power Supply Unit (PSU)

1. The power supplies shall be transformer-converted to low voltage, rectified and filtered 24 VDC (nominal) for system operation and to eliminate the possibility of line voltage being present on any internal panel components.

2. The system shall be fully supervised and contain an integral, filtered, nominal 24 VDC at 5 amps power supply, which shall comply with UL Standard 864 for power-limited operation.

3. The system shall have a separate, lockable AC circuit disconnect provided. A circuit breaker in an electrical panel containing other circuits shall not be acceptable.

4. Primary Power LED Indicator And Outputs

   a. A green LED on the power supply card shall indicate the presence of primary power.

   b. Power supply outputs shall be as follows:

      (1) 24 VDC Non-Resettable, 1.75 amp. max., power limited.

      (2) 24 VDC Resettable, 1.75 amp. max., power limited.

      (3) NOTE: Maximum combined output for both shall be 3.0 amps.

5. Battery Charger

   a. The power supply shall contain a battery charger with a maximum average charging current of 1.0 amp. (This current shall be sufficient to maintain the system batteries at full charge). If the system loses AC power, a “System Trouble” shall occur. The charger output shall be supervised and fused.

   b. Battery charger cabinet shall be equipped with a lock cylinder and be "CAT 30" Key Operative.

6. Batteries

   a. Batteries shall be supervised and monitored.

   b. Batteries shall be of sufficient capacity to provide power for the entire system upon loss of normal AC power for a period of sixty (60) hours with fifteen (15) minutes of alarm signaling at the end of this sixty-hour (60) period.

   c. Battery enclosure shall be equipped with a lock cylinder and be CAT-30 Operative.
F. Connections And Circuits

1. Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Electrical Code (NEC). The circuit and connections shall be mechanically protected. The circuit disconnect shall be located electronically before the main service disconnect. The circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM SYSTEM."

G. System Control Unit (SCU)

1. Enclosed within the system cabinet, the SCU shall contain the microprocessor, memory, system operating software stored on a non-volatile EPROM, system configuration memory stored on a non-volatile EEPROM, and the circuits necessary to support a fire alarm system. The SCU shall function as the system information and control center, processing all messages from the field devices (supervisory, trouble, alarm).

2. SCU Microprocessor
   a. The SCU microprocessor shall execute all supervisory programming to detect and report the failure or disconnection of any module or peripheral device. An isolated "watchdog" circuit shall monitor the microprocessor and upon failure shall activate the system trouble circuits and the "DEGRADE" LED.
   b. The SCU microprocessor shall access the system program, which is stored in non-volatile EEPROM memory, for all control-by-event (CBE) functions. The system program shall not be lost upon failure of both primary and secondary power. Volatile memory shall not be acceptable.
   c. A common RS485 style communications bus network shall tie the SCU microprocessor on-line with all other microprocessors within the multiprocessor network, to afford rapid response to all alarm, or trouble conditions within the system.

3. Programming/Diagnostic Center
   a. A two-character, seven-segment Programming/Diagnostic Center Display shall be provided to annunciate system operation, programming, and internal trouble-shooting features.

4. Real-Time Clock
   a. The SCU module shall contain a real-time, 24-hour military time clock monitoring all real-time programming, and all time control functions.

5. Notification Appliance Circuits
   a. Two (2) independent notification appliance circuits shall be provided on the SCU unit, each polarized and rated at 1.75 amps DC, individually FTC protected and supervised for opens, grounds, and short circuits. They shall be wired Class A, supervised and FTC protected. Specifications are as follows:

(1) Voltage Current
a) 24 VDC Non-regulated 1.75 amps: Maximum alarm.
b) .001 amps: Normal standby.

(2) Provide a minimum of one audible and one visual circuit per floor, per stair and per elevator cab.

6. Trouble Input
   a. The trouble input, if used, shall accept a 5 to 24 volt input from an external source.
   b. Trouble Dry Contacts (Form A or Form B; jumper selectable) shall be provided rated 2 amps @ 24 VDC (resistive) and shall transfer whenever a system trouble occurs.

7. Alarm Dry Contacts
   a. Alarm dry contacts (Form C) shall be provided rated 2 amps @ 24 VDC (resistive) and shall transfer whenever a system alarm occurs.

8. Digital/Addressable Signaling Line Circuits
   a. Analog/Addressable signaling line circuits (initiating/control) shall be wired as Class A, Style 7.

H. Keyboard Display Unit (KDU)
   1. Shall furnish audible and visual annunciation of all alarm, trouble, supervisory and security signals. Dedicated LED displays shall be provided for:
      a. Power (green)
      b. Controls Active (green)
      c. Fire Alarm (red)
      d. Pre-Alarm (red)
      e. Security (blue) if applicable
      f. Supervisory (yellow)
      g. System Trouble (yellow)
      h. Other Event (yellow)
      i. Signals Silenced (yellow)
      j. Point Disabled (yellow)
      k. CPU Failure (yellow)
   2. The KDU shall contain a 640 character backlit display that shall provide status of all analog/addressable sensors, monitor and control points, and a 12-key keypad that shall permit selection of functions. The display shall be of the liquid crystal type (LCD), clearly visible in the dark, and under all light conditions.
   3. The KDU shall contain eleven LED status indicators
      a. Power
      b. Controls Active
      c. Fire Alarm
      d. Pre-Alarm
      e. Security
      f. Alert
      g. Supervisory
h. Trouble
i. Signal Silence
j. CPU Failure
k. Point Disabled
l. Other event

4. The system shall support up to 32 remote ACS annunciators and modules.

I. Dual Signal Unit (DSU)

1. Dual Signal Units (DSU) shall be provided in accordance with the number of notification circuits required by the plans and specifications. Each DSU shall provide two (2) notification circuits, each polarized and rated at 1.75 amps DC, PTC protected and supervised for opens, grounds, and short circuits. They shall be capable of being wired Class A, supervised and PTC protected.

J. Fault Indicator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

K. Quad Relay Unit (QRU)

1. The Quad Relay Unit (QRU) shall provide four (4) independent Form "C" relay contacts rated 2 amps @ 24 VDC (resistive only). This relay output shall be used to perform auxiliary functions and may be programmed through the system software or may be hardwired directly from a 24 VDC input. When a QRU relay is activated, the green "ON" LED shall light.
2. Each QRU relay shall be supplied with an "OFF/AUTO/ON" control and programming switch. When the switch is manually turned off, the yellow "OFF" LED shall light.
3. All relay coils shall be supervised for opens and shall light the "OFF" LED steadily and activate the system trouble circuit when a fault condition is detected.
4. All relays may be jumper selected for default programming.

L. High-Current Relay Unit (HRU)
1. The High-current Relay Unit (HRU) shall provide four (4) independent Form "C" relay contacts rated 5 amps @ 24 VDC resistive or 1 amp @ 120 V AC inductive. This relay output shall be used to perform high-power auxiliary functions and may be programmed through the system software or may be hardwired directly from a 24 VDC input. When an HRU relay is activated, the green "ON" LED shall light.

2. Each HRU relay shall be supplied with an "OFF/AUTO/ON" control and programming switch. When the switch is manually turned off, the yellow "OFF" LED shall light.

3. All relay coils shall be supervised for opens and shall light the "OFF" LED steadily and activate the system trouble circuit when a fault condition is detected.

4. All relays may be jumper selected for default programming.

M. Meter Display Unit (MDU)

1. A Meter Display Unit (MDU) shall be supplied containing a 0-50 VDC Voltmeter, a 0-5 ADC Ammeter, and a 2-position DPDT toggle switch. The switch shall allow the operator to display either of the following conditions.
   b. Battery Voltage and Charging Current.

2.5 PERIPHERAL DEVICES

A. Smoke Detectors

1. Analog Photo Electronic Smoke Sensors for duct detection application.
   a. These sensors shall be of the photo electronic type. Each sensor shall be capable of being set at four sensitivity settings of "LOW, MEDIUM, NORMAL, and HIGH" levels, with a predefined setting of LOW.

   (1) Automatic and manual functional sensitivity and performance tests shall be possible on all. Photo electronic sensors without the need of generating smoke. This test method shall test all sensor circuitry and a "Failed Test" indication shall be provided on the KDU upon any failed test.

   (2) Two LED visual indicators providing local 360-degree visibility of operating status and alarm indication shall be provided on each sensor. The LEDs shall pulse periodically indicating that the sensor is receiving power, and communication is being supplied. This feature shall be field programmable. Upon alarm these two LEDs shall light continuously. A visible alarm signal shall be capable of being remotely annunciated.

   (3) The system shall check the sensitivity of each sensor periodically. If a sensor alarm threshold sensitivity has changed, due to aging and/or dust accumulation, the system shall automatically compensate for this sensitivity change (drift compensation).

   (4) The sensor screen and cover assembly must be easily removable for field cleaning. Wire connection shall be made by clamping plate and screw.
(5) Each sensor shall be interchangeable with the analog ionization sensor and the analog thermal sensors via twist lock mounting base, to ensure matching the proper sensor to the potential hazards of the areas being protected. In all cases, the system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.

B. AUXILIARY DEVICES

1. Analog Thermal Sensor Series
   a. Analog thermal sensors shall operate on the combination "Rate-of-Rise" and "Fixed Temperature" principles with the fixed temperature operation at 135°F unless noted otherwise. The sensor shall also contain state-of-the-art dual thermistor sensing circuitry for fast response.
   b. Two LED visual indicators providing local 360-degree visibility of operating status and alarm indication shall be provided on each sensor. The LEDs shall pulse periodically, indicating that power and communication is being supplied to the sensor. This feature shall be field programmable. Upon alarm these two LEDs shall light continuously. A visible alarm signal shall be capable of being remotely annunciated.
   c. Each sensor shall be interchangeable with the analog photo electronic sensors, and the analog ionization sensor via twist lock mounting base, to ensure matching the proper sensor to the potential hazards of the areas being protected. In all cases, the system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.

2. Addressable Monitor Module
   a. An addressable monitor module with an initiating circuit capable of being configured Class A, Style 7 shall be furnished to provide an address for individual normally open (N.O.) contact devices.
   b. The monitor module shall contain a yellow status LED that shall flash when in a quiescent mode and light continuously when activated. The status LED shall be field programmable not to provide quiescent status indication, if so desired.
   c. The monitor module shall be visible. In the event that the module is not visible (i.e., mounted above an accessible ceiling), provide a wall mounted remote indicator/test station below the ceiling in a visible location.

3. Addressable Output Module
   a. An addressable output module shall be connected to the same signaling line circuit as the analog/address-able monitor devices and shall provide a relay output (Form "C" 2 amp @ 24 VDC, resistive only), or a notification appliance circuit output (1 amp @ 24 VDC, requiring separate power input). The output module shall contain a yellow status LED, which shall be field programmable not to provide quiescent status indication, if so desired.
   b. Addressable output modules shall be located in visible locations. In the event it is not visible, provide a remote indicating test station in a visible location.
4. Manual Fire Alarm Stations:
   a. Double Action Manual Station

   (1) Furnish and install a manual station at each location indicated on the drawings or called for within this Specification. Each manual station shall be of the non-coded double action type, requiring an outer door to be lifted to expose the actuator door. Upon the pulling forward of the actuator door, the unit shall lock into a readily observable "alarm" position. The manual station shall be constructed of aluminum (6063/T5). Each manual station shall not be equipped with a break glass rod or any other part or component that breaks upon operation of the station and require replacement. Each manual station shall require a key to reset the actuated station. This key shall be keyed alike with the fire alarm control panels, battery boxes and be "CAT 30" Key Operative. CAT 30 key shall be front operable (side mounted operators will not be accepted). The manual stations shall employ a highly reliable action to activate an alarm. This feature shall provide an exceptionally high resistance to accidental operation.

   (2) Manufacturer shall be Reliable Security Group, Lakewood, CA.

5. Remote indicators
   a. Shall be LED with an integral magnetically operated remote test station. The combination shall be mounted in a single box. Separate devices will not be accepted. All remote indicators/test stations shall be visible and easily accessible at 6'-0" A.F.F. unless noted otherwise.

6. Evacuation Signal Devices
   a. All devices shall:

   (1) Be predominately red in color.
   (2) Be labeled “FIRE.”
   (3) Be in compliance with the Americans with Disabilities Act.

   b. Visual signals shall be a flashing strobe behind translucent lenses. Visual signals must be synchronized.

   (1) Exception: Synchronized visual signals are not required if the visual signals have been tested by an independent testing laboratory and shown not to induce seizures.

   c. Devices shall be engineered to comply with NFPA 72. The average ambient sound level for the various occupancies is listed below and may be used as a guide for engineering purposes.

   (1) Business occupancies 45dBA
   (2) Educational occupancies 45dBA
   (3) Industrial occupancies 80dBA
   (4) Institutional occupancies 50dBA
   (5) Mercantile occupancies 40dBA
   (6) Pier & water surrounded 40dBA
   (7) Places of Assembly 40dBA
d. Devices shall be engineered to be such in number and location as to assure the evacuation signal is readily heard in all occupied areas of the building. In no case shall the evacuation signal be less than fifteen (15) decibels above averaged ambient sound levels.

e. Audible signals shall have a sound level of not less than 75 dBA at ten (10) feet or more than 120 dBA at the minimum hearing distance from the audible appliance.

f. Buildings occupied by or having the potential to be occupied by deaf or hearing-impaired persons shall provide for occupant notification as necessary to ensure evacuation of these occupants.

g. The audio evacuation signal shall be provided with a temporal tone audio evacuation signal followed by a pre-recorded voice evacuation signal.

h. In addition the fire alarm system shall have live voice communication capabilities. Live voice communication from the fire alarm panel shall override the pre-recorded message. Should there be a failure of the pre-recorded message, the temporal tone shall be continuous.

i. The AHJ (authority having jurisdiction) must approve all pre-recorded messages.

(1) Message is to be repeated twice.

j. Exterior weatherproof audiovisual (A/V) devices shall be provided. Exterior audible devices shall be horns. Such devices shall be located in the immediate vicinity of each building entrance/exit. The exterior A/V devices shall be non-silencable and must remain in operation until the system is reset.

7. Fire Protection System Alarm Devices

a. Provide Type OSYS-U UL listed and FM approved fire protection gate valve tamper switch(es), with two single-pole/double-throw contacts, as shown on Drawings. Provide mounting bolts and hardware. Wire to fire alarm system.

b. Provide UL listed and FM approved fire protection water-flow alarm switch(es) with two single-pole/double-throw contacts, adjustable time delay and mounting collar hardware. Switch components that contact water shall be non-corrosive.

c. Provide UL listed and FM approved fire protection water pressure alarm switch(es).

2.6 AUXILIARY FUNCTIONS

A. HVAC Control (when applicable)

1. Each designated HVAC unit shall be controlled through an addressable relay unit after an alarm condition has been initiated from any device as shown on the plans.
B. Magnetic Door Holders (when applicable)

1. Electromagnetic door holders shall be provided to hold fire and smoke barrier doors open until released by an alarm condition. The door holders shall have approximately 35 lb. (15.9 kg) holding power and offer fail-safe operation. Furnish and install where shown on plans.

2. All magnetic door holders shall release through the contacts of the control panel, after an alarm condition has been initiated from any zone on the plans, or loss of power. All door holder circuits shall be separately fused.

3. Magnetic door holders shall be wall mounted behind the door with the exact location coordinated between the electrical contractor and the University of New Hampshire. Provide blocking in wall suitable to support weight of door on hold open.

4. Magnetic door holders shall operate at 24 volts DC.

5. Magnetic door/holder may utilize chain extension, not to exceed 1 foot in length, for doors that do not swing immediately next to wall.

C. Door Closers (when applicable)

1. Door closers shall be failsafe type, LCN Door closers shall be provided to hold fire and smoke barrier doors open until released by an alarm condition. The door holders shall have approximately 35 lb. (15.9 kg) holding power and offer fail-safe operation. They shall be UL listed for smoke barrier or labeled fire doors, and shall conform with life safety code, NFPA 101. Furnish and install where shown on plans.

2. All door closers shall release through the contacts of the control panel, after an alarm condition has been initiated from any zone on the plans, or loss of power. All door closers circuits shall be separately fused.

3. Door closers shall be mounted on top of the door, preferably on the top jamb (push side), with the exact location coordinated between the electrical contractor and the University of New Hampshire. Provide blocking in wall suitable to support weight of door on hold open.

4. Door closers shall allow the door to open to a minimum of 90 degrees. Provisions for wider door swing and greater hold-open angle shall be made for door closers on all doors that will be opened further than 90 degrees up to 180 degrees as required.

5. Door closer holding solenoid shall operate at 24 volts DC.

D. The system shall allow the operator to disable sprinkler system by floor, smoke detectors by floor, elevator shaft/pit/machine room devices and door holders, and individual strobe and speaker circuits. Whenever a zone or device is disabled the panel must show a trouble signal.

E. The system shall allow the operator or technician to disable any auxiliary function via the keypad.

F. Elevators

1. All elevators that travel 25 feet or more shall be connected to the building fire alarm system and be equipped with elevator recall. Each elevator lobby, at each level and the elevator machine room(s). The elevator system/fire alarm system
interface shall match existing conditions and be coordinated with UNH and current elevator service contractor, Stanley Elevator.

2.7 GRAPHIC MAP

A. Contractor shall provide a graphic layout of the building. Level of detail and size of graphic to be coordinated with UNH and Durham Fire. Graphic map to be printed on heavy bond glossy paper with indelible ink and mounted in a GD8 Graphic Display Frame supplied by Space Age Electronics, Inc., or approved equal.

2.8 RACEWAYS AND CONDUCTORS

A. All systems shall be wired as Class A such that a single break in any conductor shall not prevent the detection or signaling of an alarm.

B. All fire alarm system wiring shall be installed in conduit raceway, ¾” minimum, unless otherwise approved by the Owner. It is the responsibility of the installer to comply fully with the National Electric Code; however, particular attention shall be paid to wire fill limitations and derating requirements. All junction and pull boxes and covers shall be painted red. All boxes shall be labeled with circuit information and include the function when housing a remote control or monitor module. Each junction box shall be sized to accommodate a 40% future increase in wiring. A maximum of one box extender may be used before the contractor must use a larger box.

C. Grounding:

1. All fire alarm raceway/conduit systems shall have an equipment grounding conductor pulled in with the other fire alarm conductors. Each joint and termination must be tight so that there is electrical continuity.

2. All junction boxes, pull boxes, switch boxes, outlet boxes, etc., shall be bonded to the equipment grounding conductor by means of a green bonding jumper and screw.

D. Raceways containing conductors shall be identified as "Fire Protective Control Panel" conductors and shall not contain any other conductors. No AC current carrying conductors shall be allowed in the same raceway with the DC fire alarm detection and signaling conductors.

E. Fire alarm cable shall be UL-listed FPLR with twisted #14 AWG minimum solid copper conductors. Shielding and jacket color-coding shall be as follows:

1. Initiating circuits - solid red jacket; unshielded. If a second circuit is needed it shall be solid red jacket with an orange stripe. If more than two initiating circuits within a building shall be differentiated via permanent labeling (Brady labels or similar) at all terminations and junction/pull boxes.

2. Horn/strobe circuits - red jacket with white stripe; unshielded.

3. Speaker circuits - red jacket with blue stripe; shielded.

4. Power (24-volt) circuits - red jacket with black stripe; unshielded.

5. Communications line - red jacket with yellow stripe; shielded.
6. Audio interconnect – red jacket with green stripe; shielded
7. Booster interconnect – red jacket with purple stripe; shielded

F. Fire alarm related fiber optic cabling shall be labeled at all terminations and junction boxes to read “Fire Alarm – Do Not Remove” and to indicate source and/or destination, as applicable.

2.9 IDENTIFICATION AND LABELS

A. Labeling

1. Panels shall be labeled "Fire Alarm Control" on outside cabinet front in contrasting lettering at least 1" in height and 1/16" stroke. All labels/tags applied to the exterior of the fire alarm control panel shall be laser etched metal, mechanically secured.
2. A copy of the cabling color code schedule shall be permanently affixed in each fire alarm cabinet.

PART 3 - EXECUTION

3.1 INSTALLER’S RESPONSIBILITIES

A. The installer shall coordinate the installation of the fire alarm equipment with the manufacturer or his authorized distributor.

B. All conductors and wiring shall be installed according to the manufacturer's recommendations.

C. It shall be the installer’s responsibility to coordinate with the supplier regarding the correct wiring procedures before installing any conduits or conductors.

D. Any conflicts between the manufacturer’s wiring requirements and the wire and cable requirement specified herein shall be brought to the attention of the Owner immediately.

3.2 INSTALLATION OF SYSTEM COMPONENTS

A. System components shall be installed in accordance with the latest revisions of the appropriate NFPA Standards, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ).

B. All wire used on the fire alarm system shall be U.L. listed as fire alarm protection signaling circuit cable per the National Electrical Code, Article 760.
3.3 WIRING

A. Label wiring at all termination points.

B. Contractor shall clearly re-label all Fire Alarm Control Panels with new zones with typed labels.

C. In general, it is the intent of this specification that all fire alarm wiring be run in conduit concealed within walls and/or above ceilings. Surface mounted raceways will only be permitted as a last resort. Where surface mounted, the conduit shall be painted to match the surface mounted to. All painting shall be in accordance with University Construction Standards. Fire alarm cable shall contain a 2 – hour circuit integrity rating where required.

D. Cutting, drilling and patching of existing masonry walls shall be the responsibility of the fire alarm contractor. All holes through existing masonry shall be made with dry or wet coring only. When dry coring, a vacuum collar shall be used to control dust. Rotary hammers or demolition hammers will not be allowed. The fire alarm contractor shall be responsible for all clean up. All floor wall and ceiling penetrations shall be fire caulked using approved methods and materials and finished to match existing conditions. All fire stopping materials and methods must be submitted for approval prior to installation.

E. Notification appliance circuits shall be limited to 75 percent of available power provided by power supply.

F. Design wattage of speakers shall not exceed 80% of the maximum allowable input for the unit.

3.4 DETECTOR INSTALLATION

A. Smoke detectors shall not be installed prior to the completion of sanding/patching/cutting or painting of wall and ceilings. Should fire protection or construction circumstances mandate early installation of smoke detectors, they shall be bagged tightly in clear plastic. Should active detection be a requirement of occupancy, the plastic shall be removed at the conclusion of each workday and rebagged prior to the start of work.

B. No automatic detector shall be mounted within the airflow of a supply air register. A minimum of 36” shall be provided between detector location and air register.

3.5 LOCATION OF EQUIPMENT

A. Instruments shall be located as shown on the drawings. In general:

2. Speaker/Strobes – Ceiling mounted wherever possible or wall mounted 80” AFF or 6” below ceiling, whichever is lower.
3. Pull Stations -Wall mounted 4’ – 0” AFF.
   a. Be predominately red in color
b. Be mounted in accordance with NFPA 72

c. Be labeled “FIRE”

d. Be located within 5 feet of all exit ways from each floor, unless otherwise approved by the AHJ (authority having jurisdiction).

e. Be situated perpendicular to the wall.

f. In areas susceptible to malicious false alarms the fire department may require alarmed Lexan type covers over the pull stations.

3.6 DEVICE DESCRIPTIONS AND ZONE ASSIGNMENTS

A. Device descriptions shall be clear and concise and based on permanent room/building nomenclature, not construction drawing nomenclature. Coordinate with the Owner. Device descriptions shall utilize compass directions that are based on the assumption that Main Street in Durham runs east/west. Consistency in device descriptions for similar devices is important. Where reasonably possible while still providing for rapid response, device descriptions should avoid reference to room numbers as room numbers are subject to change. In general, the custom label a device description should direct the responding emergency personnel as close to the location of the active initiating device as possible (e.g. 3rd Fl Corridor East). The extended label should provide further detail as coordinated with AHJ. Extended label to identify side of building; consider location of FACP or responding entrance as Side A, proceeding clockwise around the building. For devices utilizing monitor modules that do not report the type of device, the device description shall include that information.

B. Zone assignments shall be established in logical grouping to allow for easy enabling and disabling of devices. For example, all pull stations should be zoned together as should all sprinkler related devices. Heat and smoke detectors should be zoned together on a floor by floor basis. Zone assignments shall be clearly posted inside the fire alarm control panel.

C. Device descriptions and zone assignments along with floor plans showing device locations and corresponding device numbers shall be submitted to the Owner and DFD for review at least three weeks in advance of anticipated acceptance testing.

D. At least two weeks prior to anticipated acceptance testing, a meeting shall be held to review device descriptions. Attendees shall include representatives from the fire alarm installer, the Owner and DFD.

E. Upon finalization, device descriptions and zone assignments shall be incorporated into the system programming prior to scheduled acceptance test.

3.7 ACCEPTANCE TEST

A. Prior to scheduling acceptance test, check system and perform preliminary testing to verify that the system operates correctly and is ready for an acceptance test.

B. No acceptance test will be conducted prior to the installation of finished floors, walls and ceiling, in new or renovated construction. Exception: When ongoing construction does not adversely affect the system in any way, and when the ongoing construction
will have no bearing on the system (i.e., conducting a final inspection on a kitchen hood system while unrelated construction is ongoing in other areas of the building).

C. Prior to final testing, the contractor shall submit to Owner a test plan noting what devices will be tested, what test methods will be used and how the test will be documented. No test will be conducted until the test plan has been approved by Owner.

D. Except as necessary to test the remote signal transmission, the premises shall be completely disconnected from UNH Dispatch. Comply with shutdown notification and restoration requirements above.

E. Before the installation shall be considered completed and acceptable, a test of the system shall be performed as follows:

1. The test shall be performed by the fire Alarm Installer in the presence of representatives of the Owner, and the DFD. An additional Fire Alarm Installer technician shall be present of assist with testing and to perform necessary field changes that may arise. At the Owner’s option, a representative of the Owner’s current fire alarm service contractor may also be present. The test shall be scheduled with all parties at least two weeks in advance.

2. The test shall include activation of every building fire alarm device to verify proper operation and correct annunciation at the control panel.

3. All tests shall be performed in accordance with the latest edition of NFPA 72. At least one-half of all tests shall be performed on battery standby power.

4. Except as necessary to test proper operation and coverage of interior and exterior A/V devices, testing may be performed in silent mode.

5. The installer shall furnish all materials required to conduct the test. This includes sources of heat and smoke (FM approved "canned" smoke). All devices shall be tested in accordance with manufacturer's testing criteria. All testing shall be non-destructive.

6. The signaling line circuits and notification appliance circuits shall be opened in at least two (2) locations per zone, to check for the presence of correct supervisory circuitry.

7. If the building is occupied at the time of the test and the system activates building audiovisual warning devices, the installer must make provisions to notify all building occupants of the test. Building occupants must be again notified when the test is complete.

8. The Fire Alarm Installer shall complete and submit to the Owner, DFD and the SFMO a certification letter stating that the system has been 100% tested, and functions in complete compliance with system specifications, manufacturer's specifications and fire department requirements. The certificate shall be signed by the installer(s). Attachments to the certification letter shall include completed NFPA Testing & Inspections and Project Completion forms, with all signature blocks executed.

9. Any failure or noncompliance during the final acceptance test indicates that the system has failed. If the failure or non-compliance cannot be corrected during the time it takes to complete the testing, a re-test must be scheduled. At the option of the Owner and DFD, the re-test may be limited to the specific failures and non-compliances. Or, the Owner and DFD may require partial or complete re-testing. The cost associated with the re-test shall be billed to the contractor.
3.8 PROJECT CLOSEOUT REQUIREMENTS

A. As-Built Drawings, Testing, and Maintenance Instructions

1. As-built drawings
   a. A complete set of "as-built" drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, junction and pull boxes, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system. The system shall not be deemed accepted or complete until these Drawings have been processed, and a paper copy is located at the fire alarm control panel. Contractor shall provide both a clean, computer generated print and a digital copy (CD) to the University. Digital copy shall be in AutoCAD and *.pdf format.
   b. The installer shall provide a printed copy of the system program, a listing of all devices and their addresses along with the initial device sensitivity report. These shall be kept with the as-built drawings on site.

2. Operating and Instruction Manuals
   a. Complete operating and instruction manuals shall be submitted prior to testing of the system. Three (3) complete sets of operating and instruction manuals shall be delivered to the owner upon completion. Manuals shall be specific to the system and/or equipment installed and shall include detailed information regarding the installation, operation, maintenance and programming. Also, each set of operation and maintenance manuals shall be provided with electronic and paper copy of all system specific programming, data files, point lists, etc. and a detailed programming instruction manual.
   b. Control panel and voice evacuation operating instructions shall be provided and prominently displayed on a separate sheet located next to the control panel and voice evacuation unit, respectively, in accordance with UL Standard 864. Coordinate with Owner’s representative.

3. Testing Frequency Instructions
   a. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment; methods for testing each individual piece of equipment, and a complete troubleshooting manual explaining how to test the primary internal parts of each piece of equipment, shall be delivered to the owner upon completion of the system.
   b. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:

   (1) Instructions for replacing any components of the system, including internal parts.
   (2) Instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.
   (3) A complete list of all equipment and components, with information as to the address and telephone number, of both the manufacturer and local supplier of each item.
B. Spare Parts

1. The contractor shall provide and turn over replacement stock to the Owner for subsequent storage in the Fire Command Center as follows (as appropriate):
   a. 5% of total smoke detectors provided for project.
   b. 5% of total temperature heat detectors provided for project.
   c. 5% of total rate of rise heat detectors provided for project.
   d. 5% of total pull stations provided for project.
   e. 5% of total 120 volt combination CO / smoke alarms provided for project.
   f. 5% of total duct smoke detectors provided for project.

END OF SECTION 16721
SECTION 16741 - TELEPHONE/DATA INSTALLATION REQUIREMENTS

1.1 GENERAL

A. UNH-Telecommunications systems shall be installed with strict adherence to all codes, standards, and manufacturers specifications. The following chapters are arranged as a working tool to help guide the installer/designer of these systems.

B. The word “shall” will be used in following statements where a topic is mandatory.

C. The word “should” will be used in following statements of recommendation.

D. Any variation of codes, standards, or manufacturers specifications shall only be permitted with explicit approval of appropriate approving authority(ies).

E. All cabling systems installed at the University shall comply with the following Codes and Standards. The cabling system described in this specification is derived in part from the recommendations made in industry standard documents. The list of documents below are incorporated by reference:

4. ANSI/TIA/EIA SP-4195 Proposed Addendum No. 5 to TIA/EIA-568-A Additional Transmission Performance Specifications for 4-Pair 100 Ohm Enhanced Category 5 Cabling – most current edition.
10. This Technical Specification and Associated Drawings.

F. If a conflict exists between applicable documents, then the order in the list above shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency.

G. Throughout this document, the following symbols will be used to identify ownership of responsibility:
PART 2 – PRODUCT

2.1 OUTSIDE PLANT INFRASTRUCTURE: (DTR/CR)

A. Underground Entrance:

1. Conduit:
   a. Shall be schedule 40 PVC conduit.

2. End Bells:
   a. 4 Inch, MFG. By CANTEX INC., PART NO. 5144106.

3. Conduit Plugs:
   a. 4 Inch, MFG. By JACKMOON USA INC., PART NO.: 40D402U.

4. Cable Rack Channel:
   a. 18 Support holes, 30 Inch Length, 28 ½ Inch bolt hole spacing. Hot rolled steel channel, hot dip galvanized.
      1) MFG. By CONDUX INTERNATIONAL, INC., PART NO.: 08380200.

5. Manhole:
   a. MFG. BY: Roberts Precast, Rotondo/Precast, Inc., or American Precast.
      1) Heavy duty precast reinforced concrete with internal dimensions of 12 ft. L x 6 ft. W x 8 ft. H in size and have a concrete minimum compressive strength of 5,000 lb. /psi. at 28 days in accordance with ASTM, reinforced in accordance with ASDM of H-20 loading. Precast units shall not have more than two (2) sections. Joints between sections shall have self-aligning V-grooves and asphaltic butyl compound joint sealant. The interior of each manhole shall have bonding inserts, hot dipped galvanized steel hardware that includes 1 inch dia. Eyebolt with 2 inch dia. pulling eyes and struts for heavy-duty adjustable notched channel cable wall racks. Each maintenance hole shall have a sump hole of at least 6 inches deep located directly below, centered on the manhole cover opening and have a cover. (ref. ANSI/TIA/EIA C.6.1.1).

   b. (Type A) Specifications.
1) Each vault shall have termaduct fittings precast into the manhole wall to accommodate (8 each) four inch (4") schedule 40 pvc ducts located on each end wall at the same elevation, opposing each other. Beginning 1 ft. off the sidewall to center of the first core and 3 ft. below top of vault to center of core. From the centerline of core #1, cores 2, 3, 4 shall be 10-inches on center and to the right of the previous. Core #5 begins a second tier at 1 ft. off the sidewall to center of the core #5 and 10-inches below the centerline of core #1. From the centerline of core #5, cores 6, 7, 8 shall be 10-inches on center and to the right of the previous.

c. (Type J) Specifications.

1) Each vault shall have termaduct fittings precast into the manhole wall to accommodate (8 each) four inch (4") schedule 40 pvc ducts located on each end wall at the same elevation, opposing each other. Each side wall shall have termaduct fittings precast into the manhole wall to accommodate (5 each) four inch (4") schedule 40 pvc ducts located at the following elevations, and directly across from each other. Beginning 1 ft. off the end wall to center of the first core and 1 ft. below top of maintenance hole to center of core. From centerline of core #1, core #2 shall be 10-inches on center and to the right of core #1. Cores 3, 4 shall be 10-inches directly below the previous. Core #5 shall be 10-inches directly below core #3.

6. Frames and Covers: (CR)

a. MFG. BY: East Jordan Iron Works, Inc. or Owner approved equal.
b. Frame: Catalog no. V-1610-6, Product no. 41610610.
c. Cover: Catalog no. V-1610-6, Product no. 41610641.
d. Each manhole shall have a cover that is cast iron heavy-duty type, suitable for H-20 street loading and have machined bearing surfaces. Telephone manholes shall have a minimum clear opening of 32 inches round. The word "COMMUNICATIONS" shall be cast on the upper side of each cover.

2.2 INSIDE PLANT INFRASTRUCTURE: (DTR/CR)

A. Horizontal Pathways:

1. Conduit:

a. New construction shall be EMT conduit. Only exception is in existing wall construction, GREENFIELD may be installed.

2. Surface Raceway:

a. Shall be WIREMOLD systems.
b. Device Mounting Bracket; G4050*
c. End Plate: part number CM-EPLA*
   i. * (Add "G" suffix for gray finish).
CHAPTER 5 – TECHNICAL CONSTRUCTION AND RENOVATION STANDARDS

TELEPHONE/DATA INSTALLATION REQUIREMENTS

3. Cable Support System:
   a. Shall be Cable tray, ladder, basket or J-hooks installed to meet all related codes, standards, and manufacturers specifications.

4. Paint:
   a. All exposed conduits/raceways shall be painted to match existing surfaces.
   b. All equipment back boards intended for Telecommunications shall be painted grey.
      i. MFG. BY: SHERWIN WILLIAMS
      ii. PART NO.: SW 7016

5. Busbar Kit, Wall-Mount:
   a. MFG. BY: CHATSWORTH PRODUCTS, INC., PART NO.: 10622-010

6. Poke-Thru work box:
   a. Shall be WIREMOLD WALKER Poke-Thru Systems compatible with Avaya/SYSTIMAX modules.
   b. RC7ATCAB: provides 2 data ports
      i. Comes with open system module adaptors for Lucent Avaya/SYSTIMAX
      ii. Requires a 3 INCH CORE HOLE
      iii. Flooring type and color of finish must be confirmed
   c. RC3ATCAB: provides 4 data ports
      i. Comes with open system module adaptors for Lucent Avaya/SYSTIMAX
      ii. Requires a 4 INCH CORE HOLE
      iii. Flooring type and color of finish must be confirmed

7. Floor Box:
   a. Shall be WIREMOLD 880 Omnibox series floor boxes.
   b. Cover Plate: part number 828GFITC (color and floor covering dictate part number)
   c. Activate Bezel: part number CM-MAB
   d. Open System Module: part number CM2-U2ATT*
   e. Open System Module: part number CM2-BL*
      i. *(Add -WHwhite,-GR=lt.gray,BK=black,-G=gray)
PART 3 – EXECUTION

3.1 OUTSIDE PLANT INFRASTRUCTURE: (OSP)

A. OSP Infrastructure (Underground Enterances Conduits)
   Reference: ANSI/TIA/EIA-569-A ANNEX C (normative)

1. General (CR):
   a. Shall be provided and installed in accordance with attached site plans or information herein.

2. Conduit (DTR/CR):
   a. A total of (8) 4-inch schedule 40 PVC Conduit encased in (3,500 psi), concrete will be provided for the main distribution between maintenance holes. Conduit couplings shall be staggered so that couplings on adjacent conduits do not lie on the same transverse plane. All conduits shall be terminated in termaduct fittings precast into the manhole walls. All concrete duct banks shall be doweled to the manholes walls, and foundation walls with rebar to prevent shearing.

      1) (ref. ANSI/TIA/EIA C.5.1.1.2)

   b. A total of (5) 4 inch schedule 40 PVC Conduit encased in (3,500 psi), concrete will be provided for the branch distribution between a maintenance hole and building entrance terminal of a building. Conduit couplings shall be staggered so that couplings on adjacent conduits do not lie on the same transverse plane. All conduits shall be terminated in termaduct fittings precast into the manhole walls. All concrete duct banks shall be doweled to the manholes walls, and foundation walls with rebar to prevent shearing.

      1) (ref. ANSI/TIA/EIA C.5.1.1.2)

   c. Each Conduit shall have a non-corrosive pull-rope or pull-tape installed in each of them.

      1) (ref. ANSI/TIA/EIA C.5.1.4.6)

   d. Each Conduit shall be proved by the use of an appropriately sized mandrel to ensure inside diameter conformity from beginning to end.

   a. The total number of bends in a conduit section run shall not exceed two 90-degree bends or equivalent of sweeps and radius bends. Each bend shall have a minimum radius in accordance with existing standards. All
offsets greater than 30 degrees shall be (RGC) rigid galvanized conduit elbows and offsets. All (RGC) rigid galvanized fittings buried below finish grade shall be field coated with asphaltum or shall have an additional outside factory coating of polyvinyl chloride or a phenolic resin epoxy material.

1) (ref. ANSI/TIA/EIA C.5.1.3.1.1, .2,.3)

4. Separation (DTR/CR):
   a. Separation from other utilities, structures, and depth of coverage shall be provided per applicable codes.
   1) (ref. ANSI/TIA/EIA C.5.1.4.3)

5. Drain Slope (DTR/CR):
   a. Should be installed such that a slope exists at all points of the run to allow drainage and prevent the accumulation of water. A drain slope of not less than 100 mm per 30 meters (4 in. per 100 ft.) is desirable.
   1) (ref. ANSI/TIA/EIA C.5.1.4.4)

6. Termination (DTR/CR):
   a. When terminating in a vault, hand hole or building foundation wall, the conduit(s) shall be cut and terminate with an end bell installed as flush to the wall surface as possible. When terminating at a pole, clamp the conduit(s) rigidly to the field side of the pole at a 90-degree separation from power. In all scenarios the conduit(s) shall be reamed, bushed, plugged with mechanical-type seals to ensure foreign matters do not enter the space.
   1) (ref. ANSI/TIA/EIA C.5.1.4.5)

7. Encasement (DTR/CR):
   a. All underground conduits shall be encased in concrete minimum 3" cover top, bottom and sides. Provide reinforcement rods where the concrete envelopes connect to manhole walls and building foundation. Reinforcing rod shall extend 5" into concrete on the manhole wall or foundation wall to minimize shearing.

B. OSP Infrastructure (underground Manholes)
Reference: ANSI/TIA/EIA-569-A ANNEX C (normative)

1. General:
   a. Shall be provided and installed in accordance with attached site plans or information herein. The installation of manholes shall begin with all exterior surfaces of the manhole and 10'-0" portion of ductbanks being
waterproof coated with coal tar epoxy bitumastic. The excavated area shall be free of obstructions for a minimum 12 inches around outside perimeter, with a 6-inch compact gravel base of uniform thickness and level. The preparation of the base shall ensure no settlement. Backfill shall consist of good compactable material, such as pea gravel, sand or clean earth fill. Backfilling should be done progressively from bottom to top surface. Minimum earth cover from roof of manhole to finished grade shall be 8 inches. In paved areas, set top of frame and cover flush with finished surface. In unpaved areas, set top of frame and cover approximately 1/2 inch above finished grade. Precast concrete extension collar lined with mortar with full bearing under frame shall be installed as necessary. Set height in field per final grade elevations. Install per manufacturer's instructions.

2. Location and Spacing (DTR):
   a. When determining manhole locations, consideration should be given to ground topology, access, building location, splicing and soil conditions. Manholes should be placed when a conduit or duct section length exceeds 150 m (500 ft).

1) (ref. ANSI/TIA/EIA C.6.1.5)

3. Cable Support System (CR/TR):
   a. Each manhole shall have racking installed in all channels and adequate hooks and related hardware to support installed cable. Splices shall be properly supported on both sides of the splice. Cable rack arms or brackets shall be provided by cable installer as required to support installed cables.

4. Cable Tags (TR):
   a. Every cable passing through a maintenance hole or entering a building shall have a permanently affixed, non-corrosive identification tag with the cable number and identified cable count clearly legible.

5. Fiber Tags (TR):
   a. Every fiber passing through a manhole or entering a building shall have a permanently affixed, non-corrosive identification tag with the fiber originating point, terminating point and identified fiber count clearly legible.

   a. Shall be designed so overall resistance to ground is less than 25 ohms. A single bare copper-grounding conductor shall wrap the vault at a height of above 6 ft. and have a bonding ribbon (#6 AWG min.) permanently bonded with an exothermic weld. The bonding ribbon shall be permanently bonded with an exothermic weld to the grounding electrode.
conductor. The grounding electrode conductor shall be centered on the vault sidewall. Provide a complete ground grid around the exterior of each manhole consisting of (4) 5/8-inch by 8'-0" long ground rods located at each corner of manhole. Interconnect the ground rods with a minimum of #4 AWG Bare Stranded copper conductor. Provide a #4 AWG Bare Stranded Copper Wire leads into manhole with a #4 AWG Bare Stranded Copper Wire loop attached around the perimeter of the interior wall of the manhole. The #4 AWG Bare Stranded Copper ground wire shall be connected to the ground rods by using exothermic weld type connectors.

C. OSP Infrastructure (Aerial Enterances): (DTR/CR/TR)
Reference: ANSI/TIA/EIA-569-A ANNEX C (normative)

1. Shall be provided and installed in accordance with attached site plans or information herein.

2. The pole to building span shall be no greater than 30 m (98 ft.), with the following minimum clearances:
   a. 102 cm (40 inches) below power at the pole
   b. 31 cm (12 inches) below power at mid span (under cable sag conditions)
   c. 11 cm (4 inches) horizontally at the building attachment
   d. 31 cm (12 inches) vertically at the building attachment
   e. 2.7 m (15.5 feet) vertically above street or driveway
   f. 3 m (10 feet) vertically above pedestrian traffic
   g. 2.5 m (8 feet) vertically above rooftops
   h. 7.4 m (23.5 feet) vertically above railroad tracks.
   i. 1.9 m (6 feet horizontally from roof conductors (antennas, etc.).

3. Riser poles shall have an appropriately sized pole guard installed over the cable, so there is no exposed cable from ground level to 10 ft. above ground level.

4. The cable(s) shall extend through the exterior wall using either a cable mast or sleeve through wall sloping downward toward the outside of the building ¼ inch per foot.

5. Point of Demarcation: In this context, the point in which Outside Plant Infrastructure is terminated, grounded and effectively identified.

3.2 INSIDE PLANT INFRASTRUCTURE: (ISP)

A. ISP Infrastructure (Telecommunications Spaces): (DTR/CR)
Reference: ANSI/TIA/EIA-569-A

1. General:
   a. Office spaces shall have two (duplex wall-plate) information outlets provided, each located on opposing walls of the room. If modular furniture is specified for a space and its placement prohibits the accessibility of an
information outlet, the telecommunications cables shall be extended continuously into the furniture and terminated in an accessible location. Coordination of furniture installation and cable installation is critical to prevent damage to furniture or cable and unnecessary labor costs.

b. Public areas shall have information outlets provided as needed for vending, laundry, wireless access points, courtesy phones, entrance phones and area of refuge phones.

c. Classrooms shall have a duplex wall plate located on the wall considered to be the front and back wall of the classroom.

d. Computer clusters/ labs shall be configured so no computer is located further than 25 ft. from an information outlet. Power outlets supporting the computers should be isolated ground type.

e. Telecommunications equipment rooms shall be defined as any space utilized explicitly for the installation of Telecommunications infrastructure such as network edge devices, equipment racks with rack mounted hardware for the termination and distribution of copper/fiber optical backbone cable, horizontal station cable. A space, which Telecommunications infrastructure terminates for the purpose of grounding and transitioning to interior rated cable, is not considered to be a Telecommunication space. In the initial design phase of a future building, consideration shall not only be made to provide the minimum space requirements for present telecom design needs, but more importantly for maximum potential growth. The minimum size will increase proportionally to the area it is intended to serve and if CATV is also distributed from the same space. If an existing buildings design, usage or current technologies change requiring the installation, termination and distribution of telecommunications infrastructures anywhere other than an existing telecommunications space, a new space will be provided meeting the same minimum requirements. Please reference the following information for specific design requirements.

2. Telecommunications spaces and pathways shall be designed so that no horizontal distribution distance exceeds 90 m (295 ft.)

3. All penetrations through a fire rated floor, walls or ceiling of a telecommunications space shall have an appropriately rated UL tested fire stop assembly installed restoring the surface to the original fire rating.

4. Telecommunications spaces shall be located (stacked) on each floor as close as possible to the center of the area served and accessible from a common area. (ref. ANSI/TIA/EIA 7.1.2)

5. All applicable codes shall be observed for the design of telecommunications spaces. (ref. ANSI/TIA/EIA 7.1.3)

6. Specifications for related facilities shall accommodate the applicable seismic zone requirements. (ref. ANSI/TIA/EIA 7.1.5)
7. Telecommunication spaces shall be used specifically for telecommunications purposes only. Controlled access to prevent accidental damage, vandalism, or theft of costly network devices is essential. (ref. ANSI/TIA/EIA 7.2.1.1)

8. Equipment not related to the support of the telecommunications closet (e.g. piping, ductwork, pneumatic tubing, etc.) shall not be installed in, pass through, or enter the telecommunications closet. (ref. ANSI/TIA/EIA 7.2.1.3)

9. Voice backbone cable entering the Building Entrance Terminal (BET) shall have lightning protection mounted directly on 4' x 8' x .75" plywood painted with two coats of a non-conductive fire-retardant overcoat (gray in color), unless otherwise noted in drawings, at the nearest practical location to the point of entry in the room.

10. Size and Spacing:
   a. There shall be a minimum of one (4 ft. D x 8 ft. W) telecommunications closet per floor. "The minimum space allocation of 32 SF must measure a minimum of 4' x 8' of unobstructed area (not 32 SF of lesser dimensions) and the T/D room doors should swing outwards. If the door must swing inward, the size of the room must be increased to accommodate the door swing."
   b. Exceptions may be approved by UNH Telecommunications where conditions warrant. Additional closets may be necessary when floor area exceeds 10,000 sq.ft. Under no circumstances will horizontal distribution distance exceeds 90 m (295 ft). 1) (ref. ANSI/TIA/EIA 7.2.2.1)

11. Closet Linkage:
   a. Multiple closets shall be interconnected with four 4-inch EMT conduits, terminating, reamed and bushed, 3-inches from any surface from which it emanates within the telecommunications closet. (ref. ANSI/TIA/EIA 7.2.2.2)

12. Walls:
   a. Left, Right, and Back walls shall have 4 FT. X 8 FT. X ¾ inch AC grade plywood mounted vertically with the A side exposed up. The plywood shall begin at floor level, be continuous to a height of 8 FT. AFF, and anchored a minimum of every 2 feet directly to drywall or masonry wall. Plywood shall be painted with two coats of a non-conductive fire-retardant overcoat (gray in color). All other wall surfaces shall be painted with a light colored paint. (ref. ANSI/TIA/EIA 7.2.4.1)

13. Lighting:
a. Fixture height shall be a minimum of 8.5 ft. above the finished floor and mounting location to be field coordinated during construction. Light intensity shall be at least 500 lux (50 footcandles) at 1 m (3.3 ft.) above the finished floor. The light switch shall be located on the right side wall. Lighting fixtures should not be powered from the same electrical distribution panel as the telecommunications equipment in the telecommunications closet. (ref. ANSI/TIA/EIA 7.2.4.2)

14. False Ceiling:
   a. Shall not be provided. (ref. ANSI/TIA/EIA 7.2.4.3)

15. Door(s):
   a. Double-doors shall be fitted with a lock, have no threshold or center post, and open into the hallway or other common area. Both doors shall be sized 91 cm (36 inches) W x 2 m (80 inches) H. (ref. ANSI/TIA/EIA 7.2.4.4)
   b. Doors for Building Entrance Terminal (BETs) shall be a single door fitted with a lock, have no threshold, and shall be sized at (91 cm (36 inches) W x 2 m (80 inches) H).

16. Floor:
   a. Shall be static free using asphalt/linoleum tile, or painted to eliminate dust. (ref. ANSI/TIA/EIA 7.2.4.5)

17. Power:
   a. Shall include a minimum of two dedicated 120volt, 20-ampere duplex outlets on separate branch circuits for equipments power. The location of these outlets shall be field coordinated during construction. There shall also be a minimum of one 120volt; 20-ampere convenience outlet located 16” to 18” AFF anywhere within the room. (ref. ANSI/TIA/EIA 7.2.4.6)

18. Equipment Racks
   a. Shall be properly anchored and grounded.

19. Climate Control:
   a. Shall be kept between 18 degrees C (64 degrees F) and 24 degrees C (78 degrees F), with relative humidity maintained within the range of 30 to 55 %. A BTU sheet will be provided to the Design team for each Telecom space.

B. ISP Infrastructure (Horizontal Pathways): (DTR/CR/TR)
   Reference: ANSI/TIA/EIA-569-A
Telecommunications pathways shall be designed and installed to minimize number of bends and length. No pathway shall exceed 90 m (295 ft.). Pathways traversing areas considered not reenterable upon completion of construction shall have EMT or ENT installed to span the distance. All Telecommunication pathways shall be dedicated for Telecommunications use only. Considerations must be given to minimum clearances, sources of EMI, temperature, maximum fill ratio and overall functionality of these pathways.

1. Minimum requirements for the installed conduits, such as support, end protection, and continuity, are found in appropriate sections of the NEC.
   (ref. ANSI/TIA/EIA 4.4.2.1)

2. No section of conduit shall be longer than 30 m (100 ft.) between pull points.
   (ref. ANSI/TIA/EIA 4.4.2.2)

3. No section of conduit shall contain more than two 90-degree bends or the equivalent of 180 degrees cumulative between pull points. If there is a reverse (U-shaped) bend in the section, 180 degrees or 100 ft is exceeded, a pull box shall be installed. All pull boxes shall be accessible as required by the NEC.
   (ref. ANSI/TIA/EIA 4.4.2.3.1)

4. The inside radius of a bend in the conduit shall be at least 6 times the internal diameter. Bends in the conduit shall not contain any kinks or other discontinuities that may have a detrimental effect on the cable sheath during cable pulling operations.
   (ref. ANSI/TIA/EIA 4.4.2.3.2)

5. Cable support systems shall originate in the telecommunications closet and extend the entire length of all main hallways on that floor.

6. Cable tray/raceways shall not be filled greater than the NEC maximum fill for the particular raceway type, and shall be incrementally increased from the furthest outlet box to the Telecommunications closet.
   (ref. ANSI/TIA/EIA 4.4.2.5.2)

7. A minimum of 1-inch EMT shall be used to serve a double-gang workbox with a single gang reducer ring.

8. From the first workbox to the second, the EMT may be reduced to ¾-inch.

9. Conduits shall be installed so they feed opposing offices in a back to back fashion. There shall be no more than 2 workboxes fed from any one EMT run.

10. Conduits shall be appropriately sized so the cable’s minimum bend radius and maximum pulling tension shall not be exceeded.

11. A minimum ¾-inch conduit shall be provided from the telecommunications closet and terminate in a back box mounted 45° OC AFF to serve each wall mounted public phone (including area of refuge and building entrance phone locations),
   (ref. ANSI/TIA/EIA 4.4.2.7)
12. A minimum ¾-inch conduit shall be provided from the telecommunications closet and terminate in the Fire Alarm Control Panel.

13. A minimum ¾-inch conduit shall be provided from the telecommunications closet and terminate in the elevator control panel.

14. Conduits shall be reamed and bushed at the point of termination. (ref. ANSI/TIA/EIA 4.4.3.1)

15. Conduits shall have pull strings installed and be identified as tel. /data. (ref. ANSI/TIA/EIA 4.4.3.3)

16. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of four-foot intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

17. Cables shall not be attached to ceiling grid or lighting support wires. Where light support for drop cable legs are required, the contractor shall install clips to support the cabling.

18. Cable pathways passing through a fire rated surface, shall have an appropriately rated UL listed fire stop assembly installed restoring the wall to the original fire rating.

19. Flex conduit (Greenfield) shall not be used as a substitute for EMT in new construction. Flex conduit shall not be used for offsets.

C. ISP Infrastructure (Horizontal Cable Installation): (TR)
Reference: ANSI/TIA/EIA-568-A

1. Cable shall be installed in accordance with manufacturer’s recommendations and best industry practices.

2. Cables shall be installed in continuous lengths from origin to destination (no splices).

3. The cable’s minimum bend radius and maximum pulling tension shall not be exceeded.

4. Cable shall be installed above fire-sprinkler systems, and shall not be attached to the system or any ancillary equipment or hardware. The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

5. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

6. Cables shall be identified by a self-adhesive label, in accordance with the System Documentation Section of this specification. The cable label shall be applied to
the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

7. Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D.) at any point in the run.
   (ref. ANSI/TIA/EIA 10.6.3.2)

8. Pulling tension on 4-pair UTP cables shall not exceed 25-pounds for a single cable or cable bundle.
   (ref. ANSI/TIA/EIA 10.6.3.2)

D. Telecommunications Grounding and Bonding Infrastructure (TR/CR)
Reference: ANSI/TIA/EIA-607

1. A Telecommunications bonding backbone (TBB) conductor shall be installed by the electrical contractor from the main electrical grounding bus bar to the Telecommunications main grounding bus bar (TMGBB). The bonding conductor shall be a minimum of no. 6 AWG, insulated green in color and terminate at the (TMGBB) with a double bolt lug connector. The lug connector shall be through bolted to the copper grounding bus provided by the electrical contractor.

2. The Telecommunications main grounding busbar (TMGBB) shall be the same specified under Part 2 PRODUCT of this document and installed by the electrical contractor in the location specified on the construction documents.

E. ISP Infrastructure Cable System Labeling (TR)

1. Labeling System:
   a. The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

2. Labels:
   a. All label printing will be machine generated using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

3. Terminal Block & Wall Plate:
   a. The cable labeling system shall be a numeric system. Each end shall be clearly labeled with a unique number, which is identical on both ends and corresponds to the self-laminated cable label. In ascending order from the
lower most floor to top most floor, a block of 200 numbers per floor shall be reserved. If more or less numbers are required, the block of numbers shall be increased/decreased by increments of 100.

4. UTP Station Cable:
   a. The cable labeling system shall be a numeric system. Each end shall be clearly labeled with a unique number, which is identical on both ends and corresponds to the terminal block and wall plate labels. Each 4 pair in a multi-port wall plate will have a sub-numeric number corresponding to the position it serves. In ascending order from the lower most floor to top most floor, a block of 200 numbers per floor shall be reserved. If more or less numbers are required, the block of numbers shall be increased/decreased by increments of 100.

5. Exception:
   a. Resident hall labeling system will correspond to the room number. When multiple wall plates are located in a room, the first plate will have the room number and a sub-numeric number corresponding to the position it serves. The additional wall plates shall have the same room number and sub-numeric numbers in ascending order starting where the previous left off.

F. ISP Infrastructure Construction Documents (DTR)
   1. A riser diagram reflecting the Telecommunications closet linkage shall be provided.
   2. UNH Tel/Data General notes shall be incorporated and read as follows:

   TEL/DATA NOTES:
   a. TELECOMMUNICATIONS PATHWAYS SHALL BE DESIGNED SO THAT NO HORIZONTAL DISTRIBUTION DISTANCE EXCEEDS 90 M (295 FT.)
   b. ALL CONDUIT RUNS INTENDED FOR INSTALLATION OF TELECOMMUNICATIONS WIRING SHALL BE A MINIMUM OF 1" EMT, RUN IN THE MOST DIRECT PATH, WITH THE MINIMUM AMOUNT OF BENDS POSSIBLE AND TO THE NEAREST ACCESSIBLE POINT.
   c. ALL CONDUIT RUNS IN EXCESS OF 100 FEET OR HAVING GREATER THAN 180 DEGREES IN BENDS, SHALL HAVE AN ADEQUATELY SIZED PULL BOX INSTALLED IN A CONVENIENT AND ACCESSIBLE LOCATION. ALL SUCH LOCATIONS SHALL BE SHOWN ON THE CONTRACTOR'S "AS-BUILT RECORD DRAWING". PULL BOXES SHALL BE SUPPORTED INDEPENDENT OF THE ASSOCIATED CONDUIT. ALL PULL BOXES INSTALLED AT THIS PROJECT SHALL BE ACCESSIBLE AFTER THE COMPLETION OF THIS BUILDING.
   d. ALL CONDUIT RUNS SHALL TERMINATE WITH A NYLON BUSHING, BE PROVIDED WITH A NYLON PULL STRING AND BE IDENTIFIED AT
BOTH ENDS WITH BRADY TAGS INDICATING THE LOCATION OF THE OPPOSITE END.

e. ALL WORK BOXES SHALL NOT BE INSTALLED BACK-TO-BACK BUT THEY SHALL BE STAGGERED.

f. ALL WORK BOXES SHALL BE SECURELY ATTACHED TO STUDS.

g. ALL WORK BOXES SHALL BE A DOUBLE-GANG METAL WORKBOX WITH A SINGLE GANG REDUCER UNLESS OTHERWISE NOTED.

h. ALL WORK BOXES AND PULL BOXES DESIGNATED FOR THE INSTALLATION OF TELECOMMUNICATIONS SHALL HAVE THE INSIDE BACK SURFACE LABELED "TEL/DATA" OR WITH THE SYMBOL OF A TRIANGLE IN PERMANENT TYPE MARKER.

i. NO MORE THAN TWO (2) WORK BOXES PER 1" BRANCH DISTRIBUTION CONDUIT.

j. ALL PENETRATIONS INTO AND OR THROUGH FIRE RATED ASSEMBLIES SHALL BE IN ACCORDANCE WITH THE 1996 BOCA CODE, CHAPTER 7, SECTION 1014.0. IT SHALL BE THE ELECTRICAL CONTRACTOR'S RESPONSIBILITY TO COORDINATE THE LOCATION OF ALL FIRE SEPARATION ASSEMBLIES WITH THE ARCHITECT PRIOR TO THE ROUGH-IN OF ANY ELECTRICAL WORK.

k. ALL PENETRATIONS OF FIRE-RATED ASSEMBLIES BY THE ELECTRICAL CONTRACTOR SHALL BE FIRESTOPPED AS REQUIRED. THE CONTRACTOR SHALL INSTALL 3M OR HEAVY-DUTY/NELSON FIRE STOPPING MATERIAL IN ACCORDANCE WITH THEIR RESPECTIVE MANUFACTURER'S DETAILS.

l. FIRE STOPPING REQUIRED WITHIN ALL TELECOMMUNICATIONS CONDUITS AND SLEEVES SHALL BE THE RESPONSIBILITY OF UNH'S COMMUNICATIONS DEPARTMENT.

m. ALL INTERIOR COMMUNICATIONS CONDUITS SHALL BE INSTALLED TO EXTEND 6" ABOVE FINISHED FLOOR OR ANY SURFACE FROM WHICH THEY EMANATE, BE REAMED, BUSHEDED AND HAVE PULL STRINGS INSTALLED.

n. ALL COMMUNICATION ENTRANCES OUTSIDE PLANT CONDUITS SHALL BE CUT, REAMED AND TERMINATE WITH AN END BELL INSTALLED AS FLUSH TO THE WALL SURFACE AS POSSIBLE. ALL CONDUITS SHALL BE PROVED BY THE APPROPRIATE SIZED MANDREL. ALL CONDUITS SHALL HAVE A 3/8" NYLON PULL ROPE INSTALLED.

3. UNH Tel/Data Symbols Legend shall be incorporated and read as follows.

**AS-BUILT DRAWINGS (TR)**

a. The installation contractor, typically UNH Telecom, will be provided with 2 sets of D size drawings at the start of the project. One set will be designated for as the central location to document all as-built information as it occurs throughout the project. The central set will be maintained by the Contractor's Foreman on a daily basis, and will be available to the Owner's Technical Representative upon request during the course of the project. Anticipated variations from the build-to drawings may be for such things as cable routing and actual outlet placement. No variations will be allowed to the planned closet termination positions of horizontal and
backbone cables, and grounding conductors unless approved in writing by the Owner.

b. The Contractor shall provide the central drawing set to the owner and or the project Architect. The marked up drawing set will accurately depict the as-built status of the system including termination locations, cable routing, and all administration labeling for the cable system. In addition, a narrative will be provided that describes any areas of difficulty encountered during the installation that could potentially cause problems to the telecommunications system. The project Architect will incorporate all changes in the projects final As-Built Drawings.

G. Area of Refuge Phones

1. New construction
   a. The area of refuge shall be provided with a two-way communication system for communication between the area of refuge and a central control point. The door to the stair enclosure or the elevator door and the associated portion of the area of refuge that the stair enclosure door or elevator door serves shall be identified by signage. (See 7.2.12.3.5.)
   b. Each area of refuge shall be sized to accommodate one wheelchair space of 760 mm x 1220 mm (30 in. x 48 in.) for every 200 occupants, or portion thereof, based on the occupant load served by the area of refuge. Such wheelchair spaces shall maintain the width of a means of egress to not less than that required for the occupant load served and to not less than 915 mm (36 in.).
   c. Each area of refuge shall be identified by a sign that reads as the follows:
      1) The sign shall conform to the requirements of ICC/ANSI A117.1, American National Standard for Accessible and Usable Buildings and Facilities, for such signage and shall display the international symbol of accessibility. Signs also shall be located as follows:
         a) At each door providing access to the area of refuge
         b) At all exits not providing an accessible means of egress, as defined in 3.3.136.1
         c) Where necessary to indicate clearly the direction to an area of refuge

END OF SECTION 16741
SECTION 16742 – CAMPUS EMERGENCY PHONE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section establishes standards for the installation of emergency phones at the University.

B. The University has five categories of emergency phones:

1. Walk ways - Blue light stanchion phones located along pathways, sidewalks, parking lots, etc. having emergency button only which autodials UNH Dispatch.
2. Bus Stop - Blue light Stanchion phones located at bus stops having emergency button only which autodials UNH Dispatch.
3. Entrance - Located at building entrances, having a emergency button which autodials UNH Dispatch and a dial pad which allows campus only dialing.
4. Refuge - Located inside a building, anywhere a “Area of Refuge” has been deemed necessary, having emergency button only which autodials UNH Dispatch.
5. Elevator - call box having emergency button only which autodials UNH Dispatch.

C. All emergency phones shall be installed under the direction of University Facilities Design and Construction and at the advice of UNH Telecommunications.

D. Emergency phones and stanchions shall be ADA compliant and have a red emergency push button that, when activated, engages the blue light strobe and signals UNH Dispatch Center. The phone speaker system shall allow bi directional communication between the Dispatch Center and emergency phone activator.

E. Phones shall be located at campus bus stops, along walkways, and other gathering or recreational areas. See Attachment A for assembly details and coordinate with Chapter 5, Division 2, Section 02751.

F. University Facilities Design and Construction will maintain an emergency phone master plan to establish current locations and the future growth of the system. The object of the plan is to provide one visible phone from any maintained walk, parking lot, or roadway on campus. The long-term goal of the plan is to provide one visible phone from any other.

1. Phone locations and changes to the master plan will be approved by an emergency phone committee consisting of representatives from:

   a. Campus Planning
   b. FD&C
   c. Grounds and Events
   d. Telecom
   e. University Police
f. VPSA

G. All phones shall be numbered per the master plan.

h. Other concerned organizations

H. Changes to this standard shall require approval by UNH Telecommunications and Facilities Design and Construction.

1.2 FUNDING

A. Installation will be funded from other project funds or annual campus repair and renovation funds. Installation will include the initial non-recurring Telecom charge.

1.3 CODES, RULES, REGULATIONS

A. Perform the work and provide material under this standard in strict accordance with applicable provisions of all governing codes, rules, laws and ordinances as amended.

B. Comply with University of New Hampshire Planning, Design and Construction Guidelines.

C. Emergency phone assemblies shall be listed by an independent testing agency, satisfactory to the New Hampshire State Fire Marshal’s Office.

1.4 SUBMITTALS

A. Any deviations from these standards must be approved by University Facilities Design and Construction and UNH Telecommunications.

1.5 QUALITY ASSURANCE

A. All electrical installations shall be done by an electrician licensed in the State of New Hampshire.

B. All telecommunication installations shall be done by the UNH Telecommunications department.

C. All stanchion, concrete, asphalt and associated work shall be done by experienced tradespersons.
PART 2 - PRODUCTS

2.1 GENERAL

A. Emergency phone equipment in this standard includes stanchions, lights, phones, and conduit. Products for concrete, asphalt, wiring, etc., are found in other sections.

B. The University has adopted the following products as the standard for the campus in order to provide consistent appearance and function:

GAI-TRONICS® Corporation
P.O.Box1060
Reading,PA19607-106USA
Phone: 1-800-492-121
Fax: (610) 796-5954

1. Stanchion: Gai-Tronics model # 234 (includes protective outer lens body, panel light, mounting hardware kit.) (Beacon and Phone sold separately)
2. Beacon: model # 530-001 (120VAC)
3. Phone:
   a. Gai-Tronics model # 297-003 (without keypad)
   b. Gai-Tronics model # 298-003 (with keypad)
   c. Gai-Tronics model # 293-003 (without keypad)
   d. Gai-Tronics model # 294-003 (with keypad)
4. Conduit: Schedule 40, 1" diameter. Provide one (1) each for power and telecommunications to sources of power and telecommunications.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Inspection:

1. Identify electrical and power conduit runs.
2. Identify Telecom terminations.
3. Coordinate UNH Dig Safe for base and conduit locations.

3.2 INSTALLATION

A. Locate as per master plan or specific project requirements.

B. Provide conduit runs to base.

C. Set stanchion anchors with plywood template at sona tube.

D. Install phones on 18’ diameter, 4’ deep concrete bases.
E. Bases shall be located between 3’ and 5’ from the sidewalk or pathway. Provide an asphalt or concrete pad, 4’ wide extending from the edge of paved surface at least to the back of the base for wheelchair access.

F. Ensure access to the keypad/emergency call button meets ADA guidelines.

G. Ensure phone is facing pathway.

H. Install stanchion plumb and level.

I. Provide numbering from master plan.

J. Prior to phone start-up, cover beacon and phone with black plastic to indicate that phone is not in operation.

3.3 START UP

A. The installing contractor will set the stanchion, verify the operation of the lights and notify University Facilities Design and Construction.

B. FD&C will notify Telecommunications that the phone is ready to activate.

C. Telecommunications will activate the phone, test and advise University Facilities Design and Construction and University Police that the phone is ready for use.

PART 4 - SYSTEM TESTING AND VERIFICATION

4.1 TESTING

A. The emergency phones are polled daily for serviceability utilizing the Gai-tronics Telephone Management Application (TMA) which Telecom monitors and responds to if any phone is identified by TMA as being faulty.

B. Periodic phone testing will be performed by UNH Police.

C. Any phones not working properly will be reported to the UNH Facilities Support Center and Telecommunications, specifying whether there is a lighting or telephone problem.

D. If the problem cannot be fixed quickly, a black plastic cover shall be placed over the strobe and phone.

4.2 VERIFICATION

A. Upon completion of repairs, UNH Facilities and Telecommunications shall notify UNH Police who shall verify operation.

END OF SECTION 16742
ATTACHMENTS:

ATTACHMENT A – STANCHION ASSEMBLY DETAIL
Model 234 Stanchion Assembly and Model 234SBA Stanchion Broadcast Assembly

Confidentiality Notice

This manual is provided solely as an installation, operation, and maintenance guide and contains sensitive business and technical information that is confidential and proprietary to GAI-Tronics. GAI-Tronics retains all intellectual property and other rights in or to the information contained herein, and such information may only be used in connection with the operation of your GAI-Tronics product or system. This manual may not be disclosed in any form, in whole or in part, directly or indirectly, to any third party.

General Information

The Model 234 Stanchion Assembly is part of a completely integrated emergency communications station. The Model 234SBA Stanchion Broadcast Assembly helps to insure public safety by combining two-way communications with one-way public address broadcasting.

Both Model 234 Stanchion Assembly and Model 234SBA Stanchion Broadcast Assembly are designed to house a flush-mount telephone and a Model 530-001 or 531A strobe. Both stanchion assemblies are over 9 feet tall, making it easily located by potential users.

The strobe creates added visibility to emergency telephone locations by providing a constant-on lamp that automatically flashes when the emergency button is pressed. The telephone is also highly visible; a light mounted in the stanchion shines on the front of the telephone to illuminate the phone for nighttime use.

GAI-Tronics enhanced emergency telephones are designed for isolated high-risk areas requiring emergency communications equipment. Emergency telephone users simply press the clearly labeled emergency push button for immediate connection to a user-programmed central security telephone number.

The Model 234SBA Stanchion Broadcast Assembly combines two-way emergency communications with one-way public address broadcasting. Each Model 234SBA is capable of being equipped with up to four public address speakers.

The complete emergency stanchion, with or without public address, is shipped in two stages. The Model 84504-201 Hardware Kit is usually shipped in advance followed by the remaining assemblies (Model 84501-201, Model 84502-201 and Model 84503-201 or Model 84509-201 and related kits). Both the Model 234 and Model 234SBA use the same hardware kit.
Mounting

A concrete pier is required to support both of the stanchion assemblies. GAI-Tronics provides the Model 84504-201 Hardware Kit to aid with the construction of this pier.

We recommend using 3,000 psi grade concrete as a minimum. The pier must be strong enough to support a structure that is 9-1/2 feet tall and weighs 250 lbs.

Reinforcement Cage

We recommend that the concrete base be 3 feet deep and 18 inches wide, and that a reinforcement cage be used. The reinforcement cage is not provided by GAI-Tronics. The following materials are necessary to construct the reinforcement cage:

- four #4 rebars;
- three #4 ties;
- one 18-inch sonotube.

1. Construct the reinforcement cage by placing a horizontal member in the center of the rebar.

2. Place the two remaining horizontal members 12 inches from that center point. See Figure 2. The top of the cage should be 3 inches below the top of the pier.

3. The reinforcement cage in Figure 2 shows the maximum diameter that is suitable for a customer-provided 18-inch sonotube.

4. Install two conduits in the pier—one for the telephone wire and one for the electrical power wire.

**NOTE:** These conduits MUST be kept separate to prevent interference from occurring on the audio lines. Conduits are not supplied by GAI-Tronics.
Installation

⚠️ ATTENTION ⚠️ Installation should be performed by qualified personnel and only in accordance with the National Electrical Code and applicable local codes.

The following information provides guidelines on the installation of various components of the emergency station. Grounding electrode conductor (not depicted in the illustration) must be constructed in accordance with the National Electrical Code and applicable local codes.

**Model 84504-201 Hardware Kit Installation**

The Model 84504-201 Hardware Kit includes four anchor bolts, which should be installed so that they extend 3 inches above the top of the pier surface. See Figure 3.

![Figure 3. Front View](image-url)
Use the template provided in the hardware kit for anchor bolt positioning, or see Figure 4 for dimensions. The 3-inch leg of the anchor bolts should point to the outside of the tube. Center lines should be measured across the corners.

**NOTE:** The stanchion should not be mounted until the concrete has been allowed to cure for a minimum of 24 hours.

Figure 4. Top View
Model 84501-201 and 84509-201 Stanchion Main Body Installation

1. If the concrete is not level, find the anchor rod at the highest point of the concrete, and screw one ¾-inch heavy hex nut 1-1/8 inches above the concrete surface (measuring to the top of the nut). See Figure 5.

2. Adjust the remaining three hex nuts to be level with the first. Place one washer over each heavy hex nut. See Figure 5 and Figure 6.

3. Before mounting the stanchion, unscrew the four tamper-resistant screws on the rear access panel, and remove the panel.

4. Apply a small amount of clear RTV silicone sealant or equivalent to each screw thread to reduce the possibility of rust forming in the screw threads.
   NOTE: GAI-Tronics Model 233-001 Tamper-Resistant Screwdriver is required to remove tamper-resistant screws.

5. Place the stanchion on top of the four level, heavy hex nuts.

6. Entering through the rear access panel hole, place the four remaining washers on the anchor bolts, and secure with the ¾-inch hex nuts. Do not install the access panel cover until the wiring is complete.
NOTE: A ¼-inch air gap must exist between the base of the stanchion and the top of the concrete pier. See Figure 6. This air gap must **not** be obstructed with soil, mulch, stone, etc.

The unit should be installed and grounded in accordance with national and local electrical codes. **NOTE:** A grounding stud connection has been provided inside the rear access panel.
Model 84503-201 Stanchion Panel Light Installation

1. Remove the two screws securing the bezel and lens to the stanchion panel light assembly.

2. Align the stanchion panel light assembly inside the stanchion as shown in Figure 7.

3. Extend the black (hot) and the white (neutral) wires to the base of the stanchion (these wires will be connected later, along with the strobe wires, to the incoming power wires in accordance with the electrical codes).

4. Secure the light assembly with the two mounting screws provided. Apply a small amount of clear RTV silicone sealant or equivalent to each screw thread to reduce the possibility of rust forming in the screw threads.

5. Insert the 7-watt compact fluorescent bulb provided with the assembly.

6. Secure the bezel and the lens to the stanchion.

Figure 7. Stanchion Panel Light Assembly
Model 530-001 or 531A Strobe and 84502-201 Lens Cover Installation

1. Insert the strobe’s seven 15-foot wires through the stanchion’s threaded nipple, and allow the wires to extend to the base of the stanchion. See Figure 8.

2. Screw the strobe onto the threaded nipple. Secure the Model 84502-201 Lens Cover with four tamper-resistant screws.

3. Apply a small amount of clear RTV silicone sealant or equivalent to each screw thread to reduce the possibility of rust forming in the screw threads.

4. Separate the orange and violet wires necessary for the telephone connection, and extend those wires through the stanchion cutout for the telephone.

![Figure 8. Strobe Assembly](image-url)
Model 40201-010 Battery Installation

1. Batteries are shipped separately and are to be installed on site. Pay strict attention to battery polarity, as reverse power will cause damage to internal components.

2. Make the wiring connection to the electronics module labeled 12V BATTERY (red+, black-) with battery cable. It is recommended that this be left disconnected from the module until you are ready to power up the unit.

3. Attach the fast-on connectors to the batteries observing polarity (red+, black-) per drawing 73520.

4. Secure the batteries into L-bracket inside stanchion under phone opening.
   
   **NOTE:** If the stanchion body does not have any L-brackets, the battery must be set in the bottom of the stanchion to the side, away from the conduit entries.

Refer to Pub. 42004-415, Model 10458-10x Electronics Paging Module Manual for interconnections and installation.

Emergency Telephone Installation

In addition to this publication, refer to the following manuals to assist in properly installing a complete station:

<table>
<thead>
<tr>
<th>Pub. No.</th>
<th>Emergency Phone Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pub. 42004-352</td>
<td>Model 297-001 and 298-001 Flush-Mount Emergency Phones</td>
</tr>
<tr>
<td>Pub. 42004-378</td>
<td>Externally-Powered ADA-Compliant Emergency Phones</td>
</tr>
<tr>
<td>Pub. 42004-397</td>
<td>VoIP Telephones</td>
</tr>
</tbody>
</table>

1. Separate the back box from the front panel of the telephone. The parts envelope inside the back box contains eight #6-32 self-tapping flat head screws, six tamperproof screws, six washers, and a hole plug.

2. Place the back box into the phone opening from the front of the stanchion. Mount the box using four of the #6-32 self-tapping flat head screws. The telephone back box has an opening in the top and one in the bottom. Plug the top opening with a hole plug. The bottom of the back box is the recommended entry location for the telephone line and strobe control wires.

   Install the phone’s front panel using the six tamper-resistant screws and six washers provided.
   
   **NOTE:** Excessive tightening will cause the panel to warp. Do not over-tighten.

   Refer to the individual phone instruction manual (as listed above) for wiring details.
Wiring Power Connections

All wiring connections should be complete at this point, with the exception of the stanchion panel light and strobe wire connections to the incoming power lines. All connections must be made in accordance with the National Electrical Code (NEC) in the United States or the Canadian Electrical Codes (CEC) in Canada. Install the power lines as follows:

1. Install the recommended ac power line surge suppressor on the protection bracket.

2. Install a ground wire between the telephone line surge protection and the grounding lug.

3. Connect the incoming ac power line to the surge protection as shown in Figure 9.

4. Connect the red, white, and green wires of the Model 530-001 AC Strobe to the surge protection as shown in Figure 9. When using the Model 531A DC Strobe, connect the red and white wires to the dc power source as shown in Figure 10.

5. Connect the black, white, and green wires of the telephone light to the surge protection.

After making these connections according to the prevailing electrical codes, replace the access panel at the stanchion base using tamper-resistant screws.
Figure 9. Interconnection Diagram with AC-Powered Strobe

Figure 10. Interconnection Diagram with DC-powered Strobe
Repairing Surface Damage to Powder-Coated Stanchions

Scratch Repair

1. Carefully sand the damaged area to clean and score the base metal, taking care to minimize any additional damage to the surrounding powder coating.

2. Wipe the sanded area with a cleaning solvent, such as DuPont “PrepSol.” Allow the area to dry. This type of product is available at auto parts stores. Denatured alcohol may also be used.

3. Prepare the bare metal surface for painting by treating it with phosphoric acid solution intended for this purpose. Allow the area to dry.

4. Using a cotton swap or small brush, paint the prepared surface with an automotive enamel or oil base polyurethane enamel such as Red Devil or Rustoleum. DO NOT USE Krylon-type paints. Carefully blend the repair enamel into the powder coat at the edges.

   NOTE: EXACT color matches may not be attainable.

Decal Repair

1. Use a sharp instrument, such as an X-Acto knife, to loosen and lift a corner edge of the damaged decal.

2. Carefully peel back and remove the loosened decal.

3. Wipe the area clean with denatured alcohol. Allow the area to dry.

4. Prior to attaching a new decal, dampen the target area with a fine mist of water (fine spray from a plant misting bottle is ideal).

5. Peel the backing from the replacement decal, leaving the decal attached to the front cover material, and carefully align it with the target area.

6. With the cover material still attached, press the replacement decal in place, then squeegee any water from under the new decal starting at the center and working toward the edges.

7. Peel off the cover material, being careful not to tear or lift the decal. If the decal lifts as the cover material is being removed, push down on the uncovered decal, and squeegee as necessary to remove any large bubbles; small bubbles will disappear as the decal dries.

Specifications

Dimensions .............................................................................. 10 W × 10 D × 114 H inches (0.25 × 0.25 × 2.89 m)

Wall thickness .............................................................................. 3/16-inch hot-rolled steel

Finish ......................................................................................... Powder-coated

Power rating (telephone light) ..................................................... 120 V ac input/0.2 amp

Approvals:

UL/cUL listed OUTDOOR telephone stanchion ........ Canadian Electrical Code, Part I (CE Code, Part I), and the ANSI/NFPA 70 National Electrical Code (NEC).
**Warranty**

**Equipment.** GAI-Tronics warrants for a period of one (1) year from the date of shipment, that any GAI-Tronics equipment supplied hereunder shall be free of defects in material and workmanship, shall comply with the then-current product specifications and product literature, and if applicable, shall be fit for the purpose specified in the agreed-upon quotation or proposal document. If (a) Seller’s goods prove to be defective in workmanship and/or material under normal and proper usage, or unfit for the purpose specified and agreed upon, and (b) Buyer’s claim is made within the warranty period set forth above, Buyer may return such goods to GAI-Tronics’ nearest depot repair facility, freight prepaid, at which time they will be repaired or replaced, at Seller’s option, without charge to Buyer. Repair or replacement shall be Buyer’s sole and exclusive remedy. The warranty period on any repaired or replacement equipment shall be the greater of the ninety (90) day repair warranty or one (1) year from the date the original equipment was shipped. In no event shall GAI-Tronics warranty obligations with respect to equipment exceed 100% of the total cost of the equipment supplied hereunder. Buyer may also be entitled to the manufacturer’s warranty on any third-party goods supplied by GAI-Tronics hereunder. The applicability of any such third-party warranty will be determined by GAI-Tronics.

**Services.** Any services GAI-Tronics provides hereunder, whether directly or through subcontractors, shall be performed in accordance with the standard of care with which such services are normally provided in the industry. If the services fail to meet the applicable industry standard, GAI-Tronics will re-perform such services at no cost to buyer to correct said deficiency to Company's satisfaction provided any and all issues are identified prior to the demobilization of the Contractor’s personnel from the work site. Re-performance of services shall be Buyer’s sole and exclusive remedy, and in no event shall GAI-Tronics warranty obligations with respect to services exceed 100% of the total cost of the services provided hereunder.

**Warranty Periods.** Every claim by Buyer alleging a defect in the goods and/or services provided hereunder shall be deemed waived unless such claim is made in writing within the applicable warranty periods as set forth above. Provided, however, that if the defect complained of is latent and not discoverable within the above warranty periods, every claim arising on account of such latent defect shall be deemed waived unless it is made in writing within a reasonable time after such latent defect is or should have been discovered by Buyer.

**Limitations / Exclusions.** The warranties herein shall not apply to, and GAI-Tronics shall not be responsible for, any damage to the goods or failure of the services supplied hereunder, to the extent caused by Buyer’s neglect, failure to follow operational and maintenance procedures provided with the equipment, or the use of technicians not specifically authorized by GAI-Tronics to maintain or service the equipment. THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE IN LIEU OF AND EXCLUDE ALL OTHER WARRANTIES AND REMEDIES, WHETHER EXPRESS OR IMPLIED BY OPERATION OF LAW OR OTHERWISE, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

**Return Policy**

If the equipment requires service, contact your Regional Service Center for a return authorization number (RA#). Equipment should be shipped prepaid to GAI-Tronics with a return authorization number and a purchase order number. If the equipment is under warranty, repairs or a replacement will be made in accordance with the warranty policy set forth above. Please include a written explanation of all defects to assist our technicians in their troubleshooting efforts.

Call 800-492-1212 (inside the USA) or 610-777-1374 (outside the USA) for help identifying the Regional Service Center closest to you.
SECTION 16781 – COMMUNICATIONS STANDARDS FOR NEW HOUSING PROJECTS

1.1 SUMMARY

A. This document provides General Specifications for the design and installation of the following Communications Systems that the University Department of Housing oversees and operates.

1. Broadband Cable TV
2. Card Access
3. Laundry Debit

1.2 Broadband Cable TV:

A. General Scope of work

1. The Contractor is responsible for providing and installing all drop cables and for installing all drop and non-drop Broadband Cable TV system pathways. The contractor is also responsible for preparing Broadband Cable TV Electronics locations as detailed further in this document.

2. Generally, a drop is defined as flexible PVC jacketed coax cable having 2 ends. One end of the cable, the initiation end (drop initiation) is located at the Node or IDP closet. The other end of the cable, the termination end (drop termination) is located where the TV is expected to be; these areas include: Living Rooms, Bedrooms, Lounges, and offices. More detail on drop type and drop location further in this document.

3. UNH Housing uses a Passive Optical Network Design to provide Broadband Cable TV to existing and new Residence halls. A Fiber Optic Node is needed for every 352 drops. Each Fiber Optic node has 4 ports and each port can feed a maximum of 88 drops. Preferably all drop initiations shall be located at the node but when this is not possible the drop initiations shall be located at an Intermediate Distribution Point (IDP) location, details of which follow in this document.

4. UNH Housing is responsible for the installation and purchase of all Electronics and non-drop cabling required for providing an active Broadband Cable TV Point of Presence in the project. UNH Housing may be able to define more cost effective exceptions to these documents specifications when an actual project design exists and can be reviewed by UNH Housing.

B. Electronics Locations:

1. Node Locations:

   a. Contractor shall designate and design for a Node location that is within 300’ of the Broadband Cable TV drop termination.
   b. Node location must be in a closet area this closet.
   c. Node locations require that contractor provide and install:
1) An Accessible 4’ across x 8’ high x ¾” thick smooth marine plywood board painted white and mounted to the wall. This is for UNH Housing personnel to mount electronics onto.

2) A minimum 20 amp, 120V dedicated 4-outlet electrical service on the upper right or left hand corner of the Node board.

d. When it is not possible to locate the Node board within 300’ of the end user terminations, it is acceptable to use Intermediate Distribution Points (for 88 drops or less) if the distance between the Node room and the IDP does not exceed 750’; that is, IDP locations shall be centrally located to the drop terminations they interface with.

e. The number of IDP locations shall not exceed the total number of drops divided by 88 and rounded up.

f. All Node, all IDP, and all pathway plans and locations shall be approved by UNH Housing before construction.

2. Intermediate Distribution Point (IDP):

a. Without prior approval Contractor shall not design for, or install in excess of, 88 drops to a single IDP.

b. Drop cable lengths shall not exceed 300’ between the IDP and the drop termination.

c. Contractor shall design for, provide, and install a minimum 2 ½” diameter pathway between the Node location and a single IDP location. This is to provide UNH Housing with a pathway for UNH Housing personnel to install a hardline Coaxial Cable and/or Fiber from the Node to the IDP/

d. If the Node serves up to 3 IDP’s in a continues circuit i.e. Vertical stacked closets, than the Contractor shall design for, provide and install a pathway between the 2 IDP’s nearest the Node such that they are a minimum of 4” in diameter.

e. IDP locations must be in an area that is not accessible to the general public.

f. The Contractor shall install an accessible 4’ across x 4’ high x ¾” thick smooth marine plywood board painted white on the wall of all IDP locations for UNH Broadband Cable TV electronics.

g. All Node, all IDP, and all pathway plans and locations shall be approved by UNH Housing before construction.

C. Outside Plant

1. Cabling Pathways

a. From the outside cable entrance (breakout room) of the building the contractor shall install a 4” conduit to the Node location. This will be UNH’s Fiber and Coax Pathway from the outside to the Node room.

b. UNH Telecommunications and UNH Housing shall coordinate outside pathway needs. These needs will be proposed to the contractor by UNH Telecommunications specifications unless indicated otherwise.

D. General Broadband Cable TV Drop Installation:
1. Broadband Cable TV Drop Locations:

   a. The contractor shall install Broadband Cable TV Drops in the specific room types as follows:

   1) All 2 Student and RA rooms shall have 1 Broadband Cable TV outlet installed.
   2) All 3 and 4 student rooms shall have 2 Broadband Cable TV outlets (2 dedicated cables from Telecommunications Closet to room) installed—both outlets may be in the same Jack box.
   3) All apartments shall have 1 Broadband Cable TV outlet installed in each of the bedrooms and 1 Broadband Cable TV outlet installed in the living room.
   4) All lounges shall have a minimum of 1 Broadband Cable TV Outlet installed
   5) All Offices shall have 1 Broadband Cable TV outlet installed.

2. Outlet Placement:

   a. Broadband Cable TV Outlets shall be placed 6” to the right of UNH Telecommunications Information Jacks. In rooms where more than 1 information Jack exists, but this specification only calls for one Broadband Cable TV outlet, then placement of the outlet is at the discretion of the designer but the outlet must still be placed 6” to the right of one of the information Jacks.

3. Broadband Cable TV Wiring Details:

   a. All outlets shall be served by a single continuous (“home-run”) Broadband Cable TV drop cable that will terminate in a Node or IDP location.
   b. All Broadband Cable TV drop cables shall be Belden™ RG6 Quad-Shield, color black, with Belden Part Number - 1189A.
   c. Drop Cable routing shall be through the floors common wireway and then if necessary through a Horizontal or Vertical sleeve and/or conduit that is dedicated to the Broadband Cable TV Network drop Cabling.
   d. Broadband Cable TV drop cable that serves only 1 Outlet shall be installed in reenterable, minimum ½” EMT that begins at the outlet box and ends at the Wireway Common Pathway. Any exposed pathways will be wiremold, or equivalent. Hidden pathways can be EMT.
   e. Broadband Cable TV drop cables that serve 2 individual outlets in 2 different rooms with a common wall shall share a re-enterable, minimum 3/4” ID, EMT that begins at the outlet box and ends at the Wireway Common Pathway.
   f. Broadband Cable TV drop cables shall be terminated at a later date by an entity appointed by UNH-Housing.
   g. Broadband Cable TV drop cables shall be installed per manufacturer’s specifications.
   h. Broadband Cable TV drop cables must extend beyond the plane of the Junction box by a minimum of 6”. This cable must be coiled into the junction box. The box shall then be covered by a contractor supplied metal F-Fitting wall plate with an Ivory White finish.
i. Broadband Cable TV drop cables that terminate in the IDF or Node locations shall be of such length that the drop can reach the farthest closet corner.

j. At each IDF and Node location all drops shall be legibly labeled corresponding to the room that the cable serves. If more than one cable serves a room then the cable will be further detailed in labeling by including the orientation of the jack in the room. i.e. E, W, N or S.

k. Contractor must provide a minimum 2 ½” pathway between the Node location and the and the IDP. This Pathway, if continues from the node room to the IDF shall have no 90 degree bends and no more than 4-45 degree bends.

1.3 Card Access

A. Contractor shall design for, provide all material for, and install all card access as defined below and as defined in the attached: Card Access Standard Version 6.1.

B. Contractor must purchase and install Card Access system using Sensormatic certified distributors and installers.

C. All building exterior doors shall have “wired” card access equipment installed.

D. All suite and/or apartment doors shall have “wireless” card access equipment installed.

E. There are 3 different exterior door system designs;

1. Card reader with lock/unlock capabilities
2. Non card reader with lock/unlock capabilities
3. Card reader with special needs access

F. UNH Department of Housing will determine what building exterior doors shall receive what system design at the time when a building design is presented, reviewed and approved by UNH Department of Housing. Department of Housing, Communications Office will then present a more detailed design as based on the Card Access System Standard Version 6.1.

G. Wireless transceivers locations shall be designed such that they share a common closet at Broadband Cable TV Nodes and IDP’s and that the transceiver location is 200’ from the wireless Integrated Lock Device it serves however this is also contingent upon building construction and materials. These locations must be approved by UNH Housing.

1.4 Laundry Debit

A. Contractor shall design for, provide all materials for, and install, all Laundry Debit equipment as defined below and as defined in the attached: Laundry Debit Standard Version 2.0
B. When an actual building design is presented, reviewed and approved by UNH Department of Housing, the Department of Housing shall provide a final and more specific laundry debit design as based on the Laundry Debit Standard Version 2.0.

END OF SECTION 16781
SECTION 17000 – BUILDING AUTOMATION SYSTEM

1.1 SUMMARY

A. The information in this Section represents current standards as of the date indicated. Due to frequent advances in BAS technology, designers are responsible for obtaining the latest BAS standards from the FD&C Project Manager.

B. Related Sections

1. Refer to Chapter 5, Division 15, Section 15180 for BAS monitoring requirements associated with district utilities.

2. Refer to Chapter 5, Division 1, Section 01815 for commissioning related requirements.

3. Refer to Chapter 5, Division 16, Section 16219 for BAS monitoring requirements associated with VFDs.

4. Refer to Chapter 5, Division 16, Section 16510 for lighting control requirements.

C. Notes to Designers:

1. The designer shall provide a proposed BAS point list to University for pre-approval prior to completion of specifications and as part of the Design Development Document submission.

2. Specialized, field or factory-installed, non-Schneider Electric Andover Continuum microprocessor control packages (e.g. automated lighting control systems, chiller control packages, roof top units, split systems) will be allowed only with special permission from the University, and will be reviewed and approved to ensure adequate provisions for communication of necessary information to the Schneider Electric Andover Continuum BAS. Modbus and BACnet-over-Ethernet are acceptable communication protocols between the Schneider Electric Andover Continuum BAS and other University-approved, non-Schneider Electric Andover Continuum devices. In general, all HVAC and lighting control functions shall be performed by the Schneider Electric Andover Continuum BAS.

3. Long or irregular occupancy zones shall be served by separate HVAC systems from those for normal “office hours” type occupancy zones.

4. Local Hand-Off-Auto (HOA) switches on motor starters for BAS-controlled equipment are not acceptable if the associated BAS controller has built-in override switches. The integral, status reporting, override switches built into the BAS controllers shall be used for the HOA function. Coordinate with Chapter 5, Division 16.

5. Discharge air temperature sensors shall be provided downstream of all heating and cooling coils (air handler coils, reheat coils, unit ventilators, fan coil units, etc.). Control of modulating terminal unit valves shall be via room and discharge reset control.

6. Provide an anti-freeze safety routine for all heating water pumps and heating zones to protect against failure of temperature sensors. Heating equipment shall be...
be indexed to the “full heat” mode if the outdoor air temperature sensor indicates a value greater than 110 degrees F., if the associated hot water supply temperature sensor indicates a value greater than 250 degrees F., if the associated discharge air temperature sensor indicates a temperature greater than 180 degrees F., or if the associated space temperature sensor indicates a value greater than 110 degrees F.

7. Temperature Control.

a. Room temperature control with the capability of automatic unoccupied setpoint shift shall be provided for all spaces with heating and/or air conditioning. Wall mounted individual room temperature sensors are preferred. Zone temperature sensors controlling several rooms shall not be allowed unless pre-approved by the University and all rooms in each zone have equal heating and cooling load characteristics and equal functional uses.

b. Perimeter radiation or local fan coil units shall be used to maintain night setback temperatures, rather than turning on large air handling systems when only a few rooms need unoccupied mode heating. An individual temperature control sensor shall be provided for each room for unoccupied heating control. Zone control for heating is not acceptable for unoccupied heating control.

c. Each temperature sensor shall have a push button override button programmed for two hour intervals of delivered heating when the system is in the night, weekend or holiday setback program. All temperature sensors in offices shall have setpoint adjustment sliders.

d. Self-contained thermostatic radiator valves cannot provide automatic temperature setback, and shall not be allowed except in spaces which require a constant room temperature 24 hours a day, seven days per week, during the entire heating season.

e. In renovations, the level of temperature control and mechanical ventilation provided by the existing building HVAC system shall be maintained or improved.

1.2 MANUFACTURERS

A. The University requires that all Primary Building HVAC systems be controlled by a complete DDC Building Automation System (BAS). The BAS system shall be Schneider Electric Andover Continuum product line. Secondary buildings shall be considered on a case by case basis. Special permission from the UNH Energy Office is required for any HVAC equipment not directly controlled by the Schneider Electric Andover Continuum BAS.

B. The BAS shall be fully integrated with the existing campus Schneider Electric Andover Continuum BAS system, and shall be fully compatible in all aspects with the existing campus BAS system hardware and software including alarm systems, energy monitoring, and hard-wired/fiber-optics communication links. The designers shall coordinate with UNH Telecommunications to ensure that the necessary fiber-optics services are included as part of the project.
C. The BAS contractor shall have a minimum of five years experience as a factory authorized Schneider Electric Andover Continnum dealer, with a fully staffed service office within 50 miles of Durham, New Hampshire.

1.3 SUBMITTALS

A. In addition to normal review, BAS contractor construction submittals shall be provided to UNH Energy Office for review. The designer shall receive written review comments from UNH Energy Office before granting final submittal approval.

1.4 SPARE PARTS

A. Contractors will be required to provide the following numbers of Infinity controllers, Net I/O modules, and EMX expansion modules to UNH prior to completion of the project. SPARE PARTS SHALL BE DELIVERED TO ENERGY OFFICE WITH SIGNED RECEIPT DELIVERED TO PROJECT MANAGER.

<table>
<thead>
<tr>
<th>Number of devices used on a project</th>
<th>Number of spares</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>0</td>
</tr>
<tr>
<td>5-10</td>
<td>1</td>
</tr>
<tr>
<td>11-20</td>
<td>2</td>
</tr>
<tr>
<td>20+</td>
<td>3</td>
</tr>
<tr>
<td>50+</td>
<td>5</td>
</tr>
<tr>
<td>100+</td>
<td>10</td>
</tr>
</tbody>
</table>

1.5 CONTROLLERS

A. Schneider Electric Andover Continnum “Net I/O” is allowed only where directly plugged into Net Controllers. Remotely wired Net I/O is not allowed except for special applications pre-approved by the University in writing. Net I/O use in quantities greater than eight total I/O modules per building shall be pre-approved in writing by the UNH.

B. The Schneider Electric Andover Continnum network controller shall be a Continuum Net Controller with 8MB minimum RAM and a node limit capacity allowing for 10 percent future node number expansion. 4MB RAM Net Controllers are allowed only with written pre-approval from the University. The Net Controller power supply shall be 120/240 VAC with the UPS option.

C. I2-800 series controllers shall be the I2-810 model with integral output override switches. I2-800 model controllers without override switches are not acceptable.

D. All BAS controllers shall be of the latest version Schneider Electric Andover Continnum Continuum/Infinity system architecture and shall be fully compatible with the existing University Continuum Cyberstation workstations.

E. All BAS controllers shall include battery-backup to maintain software programs for a minimum of twenty-four hours.
F. UL listed and labeled metallic interface panels with hinged, locked doors shall be provided for all BAS controllers, except VAV box controllers incorporating an integral damper actuator. All Control assemblies shall display third party certification and label acceptable to the New Hampshire State Fire Marshall.

G. All BAS controllers shall include LED pilot lights and software-reporting HAND-OFF-AUTO override switches for all output points. Override switches are required on all outputs for trouble-shooting by University plumbers and electricians, and for equipment testing by University preventive maintenance technicians. The only exception to the requirement for output override switches shall be for VAV box controllers, gas-fired heating equipment, unit ventilators and small fan coil units, where pre-approved by the University. HOA overrides shall not be combined with system status feedback inputs unless the combination device can differentiate (and report to the Cyberstation workstations) whether an inverse status was caused by loss of the status feedback input or by operation of an HOA override switch. Devices such as “MOB” units with a separately wired input point indicating use of override are acceptable.

H. All software to fully meet control and data logging requirements of the specifications shall be contained within a building controller. Storage of logged data is permitted on a BAS server if large volume extended logs are required.

I. Input points shall be wired to the same controller as the associated output point. Relying on an Infinet or other communications bus for input/output/setpoint control information transfer is not acceptable except in the case of global control points such as outside air temperature and humidity, building KW demand, and central plant hot and chilled water system status. Global control points shall be pre-approved in writing by UNH.

J. All input/output points and numerics associated with a specific system or piece of equipment shall be located on the same BAS controller. All BAS controllers shall include battery-backup to maintain software programs for a minimum of twenty-four hours.

1.6 BUILDING OPERATOR INTERFACE

A. Projects under 100,000 gross square feet will utilize existing UNH portable and stationary Cyberstation workstations.

B. On projects over 100,000 gross square feet the BAS contractor shall provide one desktop PC per current University specifications for that device with Continuum Cyberstation software key and Cyberstation software. This workstation shall be located on a suitable counter, with one duplex receptacle and one BAS network connection within the building, in a dedicated maintenance room, away from all water and steam piping and major mechanical/electrical equipment, with keyed door access limited to authorized personnel only.

C. The BAS contractor shall purchase any computers required by this Section for UNH from the UNH Computer Store per the existing agreement with UNH Information Technology.
1.7 BAS NETWORK REQUIREMENTS

A. The BAS has a dedicated Ethernet network system that is independent from the campus general Telecom network. The Designers must coordinate with the University to identify the BAS network connection path to building from the appropriate point in the existing BAS network. The BAS contractor shall provide interior Ethernet network wiring from the point at which the BAS network enters the building to the BAS network controller and the BAS Cyberstation if required by the project. The project shall provide labor and materials as required for connection to the existing UNH BAS fiber optic network. The project shall include external fiber optic cabling to the existing BAS fiber network, and that work shall be coordinated with UNH Telecommunications at the beginning of the design process. The designer shall determine and specify which portion of the network connection is the responsibility of the BAS contractor, and which portion is the responsibility of UNH Telecommunications.

B. The BAS contractor shall provide all Ethernet media converters, hubs, Ethernet switches, etc. required for connection of the network controller (and local Cyberstation desktop workstation, if required) to the campus BAS network.

1.8 OUTPUT DEVICES

A. All BAS output devices shall be configured/wired for "FAIL-SAFE" operation. The BAS contractor shall obtain the desired failure mode (open, closed, or "hold last position") for each output device from the University. Engineers shall specify during Design Development all output devices for the University to review and approve prior to the execution of Construction Documents. Each output device shall revert to the designated failure position on loss of BAS controller power, loss of secondary control device power, and/or loss of controller software. A separate "Failsafe" digital output shall be provided on all BAS controllers with hot water pump control outputs. Pump output control wiring shall be in series through normally open failsafe output and normally closed pump output to normally closed control relay, without software inversion of the output point. Upon loss of power or control signal, all hot water and steam control valves and return air dampers shall fail in the open position; and outside air and exhaust air dampers shall fail in the closed position. (Exception: steam valves on steam to hot water heat exchangers shall fail closed.) The fail position feature shall be spring-driven. Failure mode operation relying upon a battery or other non-spring driven device is not acceptable.

B. All valve actuators shall have sufficient power and response time for the application. All valves shall be Schneider Electric DuraDrive and have sufficient power to close against system pressures. The primary district heating system supply pressure against the primary control valve inlet port can be as high as 85 PSI at 220 degreesF. Ball valves with spring-return Schneider Electric DuraDrive actuators, or University approved substitutes, may be required for buildings with high heat loads. All ball valves shall have stainless steel ball & stem.

C. All control relays shall have integral LED indicator lights.

D. All BAS output devices shall be electric/electronic. Pneumatic control devices are not acceptable.
E. Electric modulating actuators shall directly accept either a variable voltage or 4-20 milliamp control signal. Pulse-width modulation or other methods of modulating control are not acceptable. (Exception: tri-state pulse width modulated damper actuators are allowable on VAV boxes, provided a true damper position feedback input is provided.)

F. Electric actuators shall be as manufactured by Schneider Electric DuraDrive,” no exceptions. This requirement also applies to all electric actuators that are provided as part of a UL rated smoke damper or combination fire/smoke damper.

1.9 INPUT DEVICES

A. BAS water sensing elements shall be dry type, installed in immersion wells.

B. Duct sensing elements (except freeze stats) shall be averaging type in large ducts, or in locations where air stratification may result in an unreliable reading from a probe type sensor. Averaging sensor elements shall be of sufficient length for the application.

C. Freeze stat elements shall not be averaging type. Freeze stats shall be manual reset, and shall trip if any one foot section of the sensing element falls below setpoint. Freeze stats shall be installed on all hot water and steam coils. Freeze stats shall be double pole. One pole shall be hardwired to shut off fan, open coil valve, and close outside air damper independently of the BAS. The second pole shall provide freeze stat status as a BAS input.

D. Temperature sensors shall be provided for return air, mixed air, and supply air on all air handling units. Mixed air sensing elements shall be of sufficient length to provide full coverage of the mixing box. As a minimum, averaging type sensors shall be required for all mixed and supply air ducts over 8 square feet in cross sectional area. Averaging sensors may be required for smaller ducts if the duct configuration may cause air stratification at the sensor location.

E. All temperature sensors shall be electronic thermistor type. Pneumatic devices connected to electronic transducers are not acceptable.

F. One carbon dioxide sensor calibration kit shall be provided for each model of carbon dioxide sensor used on the project.

G. Humidity sensors shall be +/- 2% RH accuracy, fully electronic with no moving parts.

H. Outside air temperature and humidity sensing elements shall be located on the building exterior, north exposure, away from windows, doors, exhaust openings, roof surfaces, and other areas that may affect accuracy. Sensors shall be located at least 15 feet above grade, and shall have physical protection for the sensing element.

I. Devices to provide positive feedback status inputs shall be installed on all fans and pumps controlled by the BAS. Pump status shall be provided by a motor current sensing transducer or load current input from VFD. All current switches shall meet UL assembly listing requirements. Fan status shall be provided by a differential pressure
switch with duct sensing probes on high and low sides of the fan (exception: current switches may be used on small units without ductwork).

J. All direct-wired dedicated alarm input devices (e.g. sump level switches) shall have normally-closed contacts.

1.10 INSTALLATION

A. The New Hampshire State Fire Marshal’s Office (NHSFMO) has ruled that all enclosures containing 2 or more electrical devices (regardless of voltage) are assemblies that require approval and labeling by an independent third party testing company that is approved by the NHSFMO. This requirement applies to both custom-built panels, and instances where an electrical device (e.g. relay or current switch) is added to an already labeled assembly (e.g. motor starter, motor control center, control panel). Adding one or more electrical devices to an already labeled assembly requires that the assembly be re-examined and re-labeled with the added components. The contractor shall be responsible for all costs associated with obtaining all electrical assembly labeling required by the NHSFMO including, where necessary, on-site field inspection and labeling by a representative from a NHSFMO-approved independent third party testing company such as UL. The University prefers that all such equipment installed on the campus have all components installed at the factory and that all third-party labeling occur at the factory when possible.

B. Provide access through ceilings, walls, and ductwork to all HVAC and control equipment requiring maintenance service or inspection. Access doors shall be 24x24 inches minimum, and labeled to indicate type of equipment inside. Provide hinged and latched access doors for service of all dampers, coils, sensing elements, and other equipment located inside ductwork or air handlers. Access openings shall be readily accessible and large enough to reach any area of the equipment that may require inspection, cleaning, lubrication, tightening, adjustment, replacement, or other maintenance service. Any access doors located in occupied spaces of the building shall have locked approved by UNH Hardware Services and keyed to meet the UNH PK525 key standard.

C. All BAS associated 120 VAC power wiring (including all input and output power supplies) shall originate from clearly-marked, BAS-dedicated circuit breakers. If UPS power or emergency power is available in the building, all BAS network connection devices and 120 VAC power wiring shall be powered from that source. If a desktop PC is required for the Building Operator Interface, the electrical contractor shall provide a duplex receptacle powered by the UPS or standby power source at the desktop PC location. All input/output transducers shall be powered from the same circuit that supplies power to the associated BAS controller. All BAS equipment shall be fused in accordance with manufacturer's recommendations.

D. Outside air temperature and humidity sensing elements shall be located on the building exterior, north exposure, away from windows, doors, exhaust openings, roof surfaces, and other areas that may affect accuracy. Sensors shall be located at least 15 feet above grade, and shall have physical protection for the sensing element.
E. All safety devices such as freeze stats, humidity high limits, and high static pressure switches shall be manual reset and shall perform all associated shutdown/failsafe actions via hardwiring. Software shall not be used to exclusively perform any shutdown/failsafe actions from safety devices. For example, freeze stats shall shut off fan, fully open coil valve, and close outside air damper via hardwiring without relying on any software functions. Software shutdown/failsafe shall be provided as a redundant backup to the required hardwired shutdowns.

F. All Schneider Electric Andover Continnum controllers shall be mounted with sufficient free space below the controller to allow for future installation of the maximum allowable number of expansion modules. Field panels shall be appropriately sized, with no wiring or other equipment located in the expansion area below the controllers.

G. BAS software shall meet University standard conventions for PID loops, optimum start/stop, alarms to the Durham/UNH Dispatch Center, BTU and energy monitoring and data storage, and other control routines. BAS contractor shall meet with UNH Director of Energy & Utilities to discuss software strategies and conventions prior to software development and as required during project duration.

H. The BAS contractor shall provide all system alarms, schedules, and optimized start/stops in accordance with current UNH BAS conventions. Alarm, schedule, and control program strategies and configuration shall be discussed with and approved by the UNH Energy Office before programming.

I. Optimized start/stop shall be provided for all heating and cooling equipment. Separate optimized start calculations shall be performed for the heating season and the cooling season. Start and stop target times shall be provided by a schedule that allows different target times for each day of the week, and for holidays and vacation periods. Provide a link to a global campus holiday numeric for certain zones as directed by the University. Schedule strategies and configuration shall be pre-approved by the University prior to beginning software development.

J. All BAS controller and point names shall reference final University room numbers, not construction document room numbers. The BAS contractor shall submit all naming conventions to the University for approval by the UNH Energy Office prior to writing final system software.

K. The BAS contractor shall provide graphical floor plan displays with final University room numbers (not construction document room numbers) on the existing University Cyberstation workstations. Additional graphic panel displays of all mechanical systems and terminal HVAC equipment shall be linked via mouse click to the floor plan displays. Spreadsheet and/or schematic type graphic panels shall be provided in accordance with standard University practices for graphic panels. Generally, animated graphic panels are not required, spreadsheet text panels are used for all systems, and schematic diagrams are used from complex systems such as large air handlers, chiller plants, and pumping/piping systems. Floor plans shall show color coded control zones with room sensors and terminal units.

L. The BAS contractor shall be responsible for maintaining, and storing off-site, contractor’s own control software and Cyberstation-related software back-ups until the end of the warranty period. The BAS contractor shall be responsible for duplicating
any work necessitated by contractor’s failure to maintain and store their own software backups until the end of the warranty period.

M. Attribute sources for all software templates shall be “copy,” not “inherit.”

1.11 AS-BUILT DOCUMENTATION

A. The BAS contractor shall provide as-built drawings and written sequences of operation that reflect final University assigned room numbers.

B. A copy of all as-built drawings shall be provided to the University as part of the final project record drawings.

C. The BAS contractor shall submit to the University copies of all graphic files and a text export file of the complete software code on a read-only CD.

D. The as built documentation shall include points list, I/O wiring diagrams, manufacturers' maintenance and troubleshooting data sheets for all BAS field devices, floor plans with all sensor and controller locations, BAS communications bus wiring diagrams showing location of the bus runs within the building, floor plan showing all electrical power panels and circuit numbers serving BAS equipment with locations of junction boxes.

E. BAS contractor shall install the following documentation in a plastic sleeved holder at each BAS controller location: written sequence of operation, controller I/O wiring diagram, controller locations, and floor plan showing sensor and controlled equipment locations.

F. At each BAS controller, the BAS contractor shall mount an output override switch chart with complete descriptive names and software point names for each override switch. The chart shall clearly indicate what equipment is controlled by each numbered override switch. This override switch chart shall be mounted separately from the documentation required above.

1.12 TRAINING

A. The BAS contractor shall provide 16 hours of on-site training on all projects exceeding 10,000 square feet. The BAS contractor shall provide an additional 40 hours of training for one person at the manufacturer's facility on all projects exceeding 50,000 square feet in size, and 80 hours at the manufacturer's facility on projects over 100,000 square feet.

1.13 TESTING AND VERIFICATION

A. The BAS contractor shall be familiar with all commissioning specifications and be responsible for providing commissioning assistance with all divisions as required and outlined in the Construction Documents.

B. All tests required by this Section shall be scheduled in advance with the University and conducted in the presence of a University representative. BAS contractor shall obtain
sign-off from the University observer and Commissioning Agent if applicable after successful completion of each test.

C. Inputs and Outputs

1. For all inputs and outputs, BAS contractor shall prepare a point-to-point verification spreadsheet with columns for point name, date of verification test, test results, and University observer sign-off.
2. BAS contractor shall verify all input points by altering conditions at the input device and observing that an appropriate change in value for that point occurs on a locally connected computer terminal. Shorting or opening wires at the input device shall be an acceptable method of altering input conditions.
3. Results of each input test shall be recorded on the verification spreadsheet.
4. BAS contractor shall verify all output points by disabling and modifying the output point value via a locally connected computer terminal and observing that an appropriate change occurs at the controlled device. Results of each output test shall be recorded on the verification spreadsheet.
5. Any points failing the initial verification test shall be re-tested and recorded on the verification spreadsheet until the point passes the verification test.
6. BAS contractor shall provide the University with the completed verification spreadsheet prior to project acceptance.

D. Local Hand-Off-Auto (HOA) switches on motor starters for BAS-controlled equipment are not acceptable if the associated BAS controller has built-in override switches. The integral, status reporting, override switches built into the BAS controllers shall be used for the HOA function. Coordinate

E. Lead-lag-standby equipment sets:

1. All lead-lag-standby equipment sets shall be tested for proper sequence of operation by causing a failure of each piece of equipment in the equipment set and observing that the appropriate back-up unit operates. Simulating equipment failure via software is not an acceptable test.

F. Dispatch Alarms

1. All Dispatch alarm software shall be of the same format as the existing Dispatch alarm software.
2. All alarms designated by the University as “Dispatch” alarms shall be tested by causing an alarm condition. Simulation of alarm conditions via software is not an acceptable test.
3. BAS Contractor shall demonstrate that an alarm signal is received at the UNH/Durham Dispatch Center alarm console when the alarm condition occurs.
4. The condition shall be left in the alarm state and the BAS contractor shall demonstrate that the alarm signal at the Dispatch Center alarm console clears when the alarm is acknowledged at a University Cyberstation workstation.
5. The alarm condition shall then be returned to normal and the BAS contractor shall demonstrate that the active alarm display indicates a return to normal condition at a University Cyberstation workstation.

G. Trend Logs
1. BAS Contractor shall set up Cyberstation trend log groups and log configurations on designated inputs, outputs, and numerics.

2. Generally, each system, control zone, or HVAC unit shall have a separate trend group. BAS contractor shall meet with the University to identify group names, point log types and intervals, and group member lists.

3. In order to provide historical trend logs covering an entire weekend period, most trended points will require logs with 128 entries at 30 minute intervals. BAS contractor shall provide extended logs if the field controller memory cannot accommodate the required number of log entries.

4. The BAS contractor shall review trend logs with the UNH to confirm proper operation of control sequences and shall perform all required software/hardware modifications to obtain proper operation.

H. Modulating Control Loops

1. Each modulating control loop shall be inspected by the BAS contractor for stability and response time.

2. Inspections shall take place at a University Cyberstation workstation with a UNH Energy Office representative and the University Project Manager present.

3. Each modulating control loop shall be tested by creating a significant change in the setpoint numeric and, after five minutes, returning the setpoint to its normal value. Response time to return to the normal setpoint shall be a maximum of 5 minutes. Certain types of outputs, as determined by the University, will require faster response time.

4. Oscillations during the response time period shall not exceed 10 percent of the setpoint value.

5. At the end of the response time, control loops shall maintain setpoint within the following tolerances:

   - **Air Pressure**: +/- 0.5" w.g. range 0-6" w.g.
     +/- 0.01" w.g. range –0.1 to 0.1” w.g.
   - **Airflow**: +/- 2 percent of setpoint in cfm
   - **Temperature**: +/- 1.0 degrees F
   - **Humidity**: +/- 5% RH
   - **Fluid Pressure**: +/- 2.0 psi range 1-150 psi
     +/- 2.0” w.g. range 0-50” differential pressure

6. BAS Contractor shall tune modulating control loops as needed to meet the requirements of this Section.

END OF SECTION 17000