Design and Construction Standards

Alamo Colleges

ALAMO COLLEGES

April 31 2025

Revisions

Version Control

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4/18/2019	2	Access Control	28 13 00
4/18/2019	3	Sanitary Sewer Line	22 00 01
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Division 00 - Introduction and Professional Requirements

SECTION 00 00 00 – INTRODUCTION

PART 1 - Overview

A. Design standards, which include both ***Educational Standards*** and ***Design and Construction Standards,*** have been created as the foundation for the design of all Alamo Community College District (ACCD) facilities. ***Education Standards*** describe space requirements for each educational space and include typical room layouts. ***Design and Construction Standards*** are the basis for the design, construction, operation, renovation, modification, and general care of the facilities at ACCD. These two documents should be used in conjunction with each other in developing designs and modifications to ACCD facilities. The ***Design and Construction Standards*** are described below, the ***Education Standards*** are presented in a separate document.

The intent of the ***Design and Construction Standards*** is to be a ***guide*** for all of those who will be using them, as they represent the preferred methods, materials, and systems. It is, however, the responsibility of the design professional to use these standards as a basis for creative solutions that meet the objectives of each ACCD project. If there are any reasons to deviate from these standards, a written request will be submitted for approval by the ACCD Facilities Department.

The standards have been developed for all typical ACCD requirements. However, ACCD will have specific projects that are not addressed in these standards and these special requirements should be discussed during the Project Definition phase. The design professional is responsible for developing documentation and specifications for all products to be used, including products not listed in the standards.

PART 2 - Contracting Requirements

2.1 Owner / Consultant Agreement

A. The design professional hired by ACCD shall have a contract in place with ACCD and a clear Scope of Work that has been reviewed as part of a work-session with ACCD prior to commencing work.

2.2 Sub-Consultants

A. The design professional hired by ACCD shall provide a list of proposed sub-consultants to ACCD, who reserves the right to reject any person or firm which ACCD may deem to not be qualified or competent to render the services required. Consultants may include:
   1. Architect
   2. Mechanical, Electrical, Plumbing
   3. Structural
   4. Civil

5. Landscape Architect
6. Roofing Consultant
7. Acoustical Consultant
8. Lighting Consultant
9. Other

2.3 Sub-Consultant Agreements

1. Sub-Consultant agreements shall match the consultant agreements. The design professional contracted with ACCD shall provide copies of the sub-consultant agreements to ACCD when requested.

PART 3 - Consultant Responsibilities

3.1 Intention and Use of These Standards

A. The Educational Standards and the Design and Construction Standards are intended to establish standards, policies, and practices and are to be used as the basis for decisions on design, construction documents and specifications. They should be used as a guide only and are not intended to cover every situation or to restrict innovative design. Where good design dictates a deviation from the design standards, the design professional should submit a written Request for Variation (RFV) to ACCD's project manager for approval by the ACCD Facility Department.

The standards are intended to provide the consultant with a basis for making product selections, establishing project standards, performing calculations for MEP systems and completing designs of all systems. These guidelines are not intended, in any case, to take precedence over any code requirements, more stringent criteria based upon "good design and engineering practice," or other known requirements. The design professional shall notify ACCD of any deviation or exceptions that are desired or required by submitting a Request for Variance (RFV) to ACCD's project manager for approval by the ACCD Facility Department.

ACCD's project manager and the ACCD Facility Department will review any Requests for Variation (RFV) and, if it is agreed that a variation or deviation is in order, a written deviation will be granted. No deviation from the design standards will be allowed without written approval. The purpose of these design standards is to provide uniformity of design based on ACCD's standards and policy.

The following page contains a sample of the Request for Variance Form.

REQUEST FOR VARIANCE
FROM THE ALAMO COLLEGES DISTRICT
DESIGN AND CONSTRUCTION STANDARDS

Project: _____
Campus: _____
Consultant with ACD: _____
Agreement: _____

Requested By: _____
_____
Date: _____

To: _____
_____
_____

Attention: _____
Spec. Reference: _____
Subject: _____
Description/Explanation:

Construction Manager: ☐ Recommended ☐ Recommended as Noted ☐ Not Recommended
Comment:

Architect's Designated Representative: ☐ Recommended ☐ Recommended as Noted ☐ Not Recommended
Comment:

Program Management Representative: ☐ Recommended ☐ Recommended as Noted ☐ Not Recommended
Comment:

ACD Project Manager: ☐ Recommended ☐ Recommended as Noted ☐ Not Recommended
Comment:

Facilities Architect of Colleges: ☐ Accepted ☐ Accepted as Noted ☐ Not Accepted
Comment:

Director of Construction Management: ☐ Accepted ☐ Accepted as Noted ☐ Not Accepted
Comment:

Design professionals contracted for specific projects have legal responsibility for design and document preparation. When specifications are required, they shall be written by the design professional for each specific project. These Design and Construction Standards are not specifications and may not be reproduced as such.

Existing or as-built drawings of renovated buildings or other areas cannot be assumed to be 100% accurate; therefore, the design professional is required to visit the site, conduct a site survey, inspect existing conditions, and record observations.

PART 4 - ACCD Requirements

4.1 Project Team

A. ACCD will furnish the manager of the design team with a list of team members, including all user group team members. The list will establish approval and authority levels to be observed by all team members.

4.2 Budget and Schedule

A. ACCD will furnish the manager of the design team with the initial budget and schedule to be used as a basis for the project budget and schedule.

4.3 Land Survey

A. ACCD will furnish the land survey of the site. In order to assist ACCD in providing the most comprehensive information from the registered professional land surveyor (RPLS) in the State of Texas, ACCD will provide a standard requirement for land surveying and request that design professionals recommend and/or modify the requirements based on the scope of work.

4.4 Geotechnical

A. ACCD will furnish geotechnical consultant services when ACCD agrees that such services are necessary. In order to assist ACCD in providing the most constructive information from the geotechnical consultant, ACCD will provide a standard requirement for geotechnical services and request that design professionals recommend and/or modify the requirements based on the scope of work.

4.5 Hazardous Materials

A. ACCD will furnish a copy of a hazardous materials survey (when a survey has been performed on an existing building and/or site) to the manager of the design team, and will be responsible for the abatement of the site and/or building as required

for new construction and/or renovations. Hazardous materials surveys shall be distributed during Project Definition phase.

Hazardous materials include organic growth within existing structures. Any suspicious materials, organic or other materials, found by the design professional during site investigation, shall be brought to the attention of ACCD's project manager

PART 5 - Design Management Responsibilities

5.1 Project Kick-Off Meeting

A. It is important for the success of the project for the team to have good communication. To begin this communication effort and promote team collaboration, a Project Kick-Off meeting should be scheduled to include the manager of the design team, ACCD's project manager, and all other key design and ACCD team members. A thorough discussion of each of the following topics is critical to making sure the team is "off on the right foot." The key topics for this meeting should include:

1. Project process
2. Project phases (project definition, schematic design, design development, construction documents, bidding, and construction)
3. Project schedule
4. Meeting schedule
5. Documentation requirements
6. Management Report requirements

5.2 Management Report

A. The manager of the design team will be responsible for providing a written monthly progress report to ACCD's project manager during the design phase of the project. The report will discuss accomplishments, schedule updates, outstanding issues, and work scheduled for the next month.

5.3 Schedule

A. The manager of the design team will be responsible for maintaining the schedule and providing periodic updates to ACCD's project manager during the design phase of the project.

A schedule for the project shall be developed to include:

1. Project Definition
2. Workshops
3. Programming
4. Conceptual Design
5. ACCD Review and Approval
6. Schematic Design
7. Cost Estimating
8. ACCD Review and Approval
9. Design Development
10. Cost Estimating
11. ACCD Review and Approval
12. Construction Documentation – 65%
13. ACCD Review and Approval
14. Construction Documentation – 98%
15. ACCD Review and Approval
16. Construction Documentation – 100%
17. Solicitation for Construction Contracting
18. Estimated Construction Mobilization
19. Estimated Construction Period
20. Substantial Completion
21. ACCD Review and Approval
22. Warranty Completion

5.4 Project Directory

A. The manager of the design team will be responsible for developing a project directory listing all team members and sub-consultant groups, including all team member names, companies, phone numbers,

fax numbers (if provided), and e-mail addresses. The directory shall be distributed to the team and ACCD's project manager.

PART 6 - Project Phases

6.1 The design team will use the following standard phases for the development of design and documentation for the project. A brief description of each phase is listed below. A more detailed description is included in Sections 00 00 02 – 00 00 07 of these Design and Construction Standards listed by each professional discipline.

6.2 Programing Definition

A. In order to establish a project scope that can be delivered within the constraints of

cost, schedule, and quality requirements; ACCD requires a Project Definition phase, during which the project team will work together to establish values, goals, strategies, and detailed requirements. This phase is explained in more detail in Section 00 00 01 of the Design and Construction Standards. The basic components include:

1. Workshop / Big Picture Concepts
2. Program
3. Develop Building Systems
4. Develop Cost Model
5. Conceptual Design
6. Process Definition

6.3 Schematic Design

A. Upon approval of the Program, Cost Model, and Conceptual Design, the design team will proceed into Schematic Design. During this phase, it is the design team's objective to work out all major design concepts and define all major decisions.

To complete this phase the design professionals will develop drawings and/or brief narratives as required to convey concept. Code analyses shall be started and a cost estimate developed. Documentation shall be submitted to ACCD for review, comments and approval.

6.4 Design Development

A. The design team shall proceed to Design Development upon receipt of Schematic Design comments and approval. During Design Development all design decisions should be finalized, and documented in drawings and outline specifications. Code analysis shall be finalized and a revised cost estimate.

developed. Design Development documents shall be submitted to ACCD for review, comments and approval.

6.5 Construction Documentation

A. The design team shall proceed with Construction Documents upon receipt of Design Development comments and approval.

Construction Documents shall reflect all previous design decisions developed during Design Development. During this phase, details should be finalized and drawings completely integrated between all disciplines. The Construction Documents are to be issued in three submittals, a 65% submittal, a 98% submittal (which are 100% complete documents for the design professionals, lacking only final comments from ACCD), and a 100% submittal with comments from the previous submittal integrated in the documentation.

6.6 Solicitation for Construction Contracting

A. Solicitation for Construction Contracting is typically the responsibility of ACCD's acquisitions department. The design professionals will be asked to respond to bidding questions as needed; and will also assist in evaluating, grading and ranking proposals as directed by the project manager. Fee for this service will typically be included in the lump sum pre-negotiated fee structure.

6.7 Construction Administration

A. During Construction Administration the design team will be responsible for submittals, construction review, and project team meetings as determined in the scope of work. Fee for this service will typically be included in the lump sum pre-negotiated fee structure.

It is anticipated that the manager of the design team will attend bi- weekly meetings, and visit the site weekly at a minimum. Each design professional shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work and shall process submittals etc. as appropriate to the scope of work.

6.8 Substantial Completion

A. The design professionals will be responsible for walking the project and developing a Punch List, at the time of substantial completion as agreed to by the contractor and ACCD's project manager.

6.9 Warranty Period

A. The design professionals will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contactor may request additional services for review and professional opinions from the design professional.

PART 7 - Submittal Requirements

7

7.1 ACCD has minimum submittal/review requirements as listed below. The manager of the design team shall indicate the dates on the schedule. Submittals include:

A. Program Review
B. Conceptual Plan / Cost Model Review Schematic Design Review
C. Design Development Review
D. Construction Document 65% Review
E. Construction Document 98% Review

7.2 More specific submittal requirements for each design discipline are written in Sections 00 00 02 – 00 00 07 of these standards.

7.3 The copies of each submittal shall be submitted through ACCD's project manager. The submittal/reviews listed shall be scheduled to allow a 5 – 10 day review period, based on the submittal and complexity of the project.

7.4 Intermediate reviews are encouraged as needed for intermediate feedback from ACCD when the scope of the project has been changed, an earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was not accepted by ACCD in whole or part. It is important for both ACCD and the design team to work closely through the process and review items as needed, in order to help expedite the construction document and construction period, without conflicts.

PART 8 - Codes and Standards

8

8.1 The design professional shall prepare a written codes and standards analysis for each project for review by ACCD.

ACCD encourages reviews with local code officials to discuss code analysis and interpretations on projects, especially projects that have complicated code issues and/or where interpretation is necessary.

The manager of the design team shall arrange the review to allow an ACCD representative to attend.

B. The following is a list of codes that should be followed, using the currently adopted versions. Codes, including all adopted versions and amendments, shall be followed by the governing jurisdiction. Where duplication of requirements occurs between codes, the more stringent requirements shall be followed.

2. Architectural Design
   - b. International Building Code
   - c. National Fire Protection Association National Fire Codes, with emphasis on NFPA 101 Life Safety Codes, including all referenced standards.
   - d. NFPA 45, Standard on Fire Protection for Laboratories using Chemicals.
   - e. Americans with Disabilities Act (ADA)
   - f. Texas Department of Licensing and Regulation, Elimination of Architectural Barriers , Texas Accessibility Standards (TAS)
3. Structural Design
   - b. Uniform Building Code
   - c. International Build Code
   - d. ACI, 318, Building Code Requirements for Reinforced Concrete
   - e. AISC, Specification for the Design, Fabrication and Erection of Structural Steel

f. Refer to Division 3 and 5 of these standards for more detail on code requirements.

4. Mechanical Design
   b. International Building Code
   c. International Mechanical Code
   d. International Plumbing Code
   e. National Fire Protection Association National Fire Codes with emphasis on NFPA 101, 90A, 54, etc).
   f. Refer to Division 22 and 23 of these standards for more detail on code requirements.
5. Electrical Design
   b. National Electrical Code
   c. National Electrical Safety Code
   d. National Fire Protection Association
   e. City of San Antonio Electrical Codes and Ordinances
   f. Terms and Conditions of the Electrical Utility
   g. Refer to Division 26 of these standards for more detail on code requirements.
6. Civil Design
   b. Uniform Building Code
   c. International Building Code
   d. City of San Antonio Unified Development Code
   e. City of San Antonio Standard Specification for Public Work Construction as Amended
   f. City of San Antonio Handbook for Flatwork Construction
   g. Texas Manual on Uniform Traffic Control Devices
   h. Americans with Disabilities Act (ADA)
   i. Texas Department of Licensing and Regulation, Elimination of Architectural Barriers Act, Texas Accessibility Standards (TAS)
7. Landscape Design
   b. City of San Antonio Tree Preservation Ordinance
   c. City of San Antonio Landscape Ordinance
   d. Americans with Disabilities Act (ADA)
   e. Texas Department of Licensing and Regulation, Elimination of Architectural Barriers Act, Texas Accessibility Standards (TAS)
   f. Refer to Division 32 of these standards for more detail on code requirements.
8. Americans with Disabilities Act and Texas Accessibility Standards
   b. Americans with Disabilities Act (ADA) and the Texas Accessibility Standards (TAS) as applied by the Texas Department of Licensing and Regulation, shall be followed when designing the project for ACCD. The design professional shall work to integrate accessibility into the overall design concept; it should not be an afterthought.
   c. Renovation projects must bring the renovated area and access to that area up to compliance. If the renovation is more than 50% of the building, the entire building should be brought up to compliance.
   d. The building(s) site(s) will need to be carefully planned so that the grades provide accessibility to the entrance, sidewalks and parking

areas.

e. Ramps should be integrated into the entrance design, if necessary. Wheelchair lifts are not encouraged.

f. Parking areas are to be marked with signs and accessible routes shall meet gradient requirements and be free of obstructions.

g. Sidewalks and use of curb ramps need to be carefully planned in the site work design.

h. All entrances shall be barrier free. Doors shall have electronically equipped automatic door openers as requested by ACCD.

i. The manager of the design team is required by TAS to submit drawings for review by a licensed reviewer as described by the TAS.

j. Note the plan review fee will be reimbursed by ACCD to the professional submitting the drawings.

k. The submitter should submit the fee for the drawing review and the one year inspection at the same time. This helps to ensure that ACCD will have their inspections done in a timely manner. It is also helpful to have the same reviewer do the inspection as well.

l. Additional fee may be required if drawings need to be resubmitted based on previous comments.

m. It is the responsibility of the design professional to design the building and/or site to meet ADA and TAS requirements.

PART 9 – Sustainable Design

9.1 *With the ideal of creating a positive future for its students, Alamo Colleges strives to create campuses where the environment and sustainable design are considered. Although not currently requiring or seeking environmental certification on its buildings, designers and contractors should, where possible, utilize environmentally friendly designs and products from frameworks such as USGBC (US Green Building Council) LEED (Leadership in Environmental Design) Silver or above where possible and economically justified.*

B. *Considerations should be made to:*

1. *Meet or exceed federal, state, and local environmental quality standards.*
2. *Decrease energy use without compromising comfort standards needed to ensure continued quality in the educational process.*
3. *Recycle waste whenever the opportunity exists.*
4. *Purchase recycled products for use whenever economically feasible.*
5. *Evaluate the environmental consequences of proposed actions as an integral part of the decision-making process.*
6. *Cooperate with community efforts to reduce pollution and to provide College District students, faculty, staff, and local citizenry with a better place to live, work, learn, and play.*

9.2 *Sustainability Practices*

B. *Products*

1. *Alamo Colleges wishes to utilize products whose manufacture and use has minimal environmental impact. The Designer of Record and Contractor should provide options for such materials. Where economically justified, these products will be utilized in new construction.*

C. *Demolition*

1. *During demolition, the Contractor should strive to recycle or salvage as much of the demolished building product as possible and to reduce and minimize the amount sent to landfills.*
2. *Salvage*
   b. *Many of the Alamo College's campuses have structures of a historic nature. When renovating or demolishing these structures, Alamo Colleges has utilized salvage contractors to remove many of the building components and materials. Items such as wooden doors and windows, antique fixtures, steel piping, lead plumbing traps, cast iron vent piping, wood beams, wood siding, and other unique items are salvageable. The Designer of Record and Contractor should consider employing a sub-contractor during demolition to remove any items of value rather than simply demolishing the building and sending the material to the landfill.*
3. *Recycling- High-mass or high-volume items that can be recycled:*
   - *i Steel- structural framing, metal studs, iron piping, conduit, cast iron bathtubs, cast iron sewer piping, door and window frames, equipment, metal ductwork, light fixtures*
   - *ii Copper- electrical wiring, plumbing piping*
   - *iii Other metals (aluminum, brass, lead, etc)- aluminum window frames, brass plumbing fixtures, lead waste lines.*
   - *iv Wood (used as bio-fuel)- lumber, cut trees, cabinetry, old furniture, door and window frames*

   c. *Other high-mass or high-volume items that may be recycled:*
   - *i Asphalt paving- there are recyclers for this according to USGBC*
   - *ii Brick (face brick, CMU, pavers)- Can brick be salvaged? Reuse of pavers?*
   - *iii Concrete (structural concrete, flatwork, fireproofing)*
   - *iv Ceramic tile and cement plaster*
   - *v Gypsum board- Note that pre-1980 gypsum board can contain asbestos. Non-ACM gypsum board can be used in cement manufacturing or agricultural products*
   - *vi Roofing material other than metal- there are recyclers for this according to USGBC*
   - *vii Glass- glazing, light fixtures,*

D. *Systems Design*

1. *Systems to consider in design*
   b. *Building orientation guidance for sun/shade and prevailing breeze*
   c. *Evaluation for PV (solar) array on roof*
   d. *Louvered systems or balconies protecting windows from direct sunlight*
   e. *Daylighting (fenestration, light shelves, light tubes, etc.)*
   f. *Runoff/rainwater catchment for irrigation*
   g. *Condensate reclamation*
   h. *HVAC that optimizes both cost and greenhouse gas (heat pumps, electric heat, electric only if heat pump, natural gas condensing boilers)*
   i. *Mag-lev chiller equipment*
   j. *CO2 refrigerant heat pumps, VRF (Variable Refrigerant Flow), and thermal storage*

integrated heat pumps

k. *Low Impact Development principles for stormwater and pavements*
l. *Cool or permeable pavements*
m. *Thermal storage (including advanced materials e.g. phase change)*
n. *Advanced and smart metering, and monitoring-based commissioning*
o. *Advanced automation and controls, and demand response sequences and capacities*
p. *Electrochemical water treatment for cooling towers, and blowdown recovery system for cooling towers, etc.*

2. *Other Systems/solutions to consider*
   b. *ASHRAE 90.1 adoption for enhanced building performance targets*
   c. *Eval/test for ground source heat pumps*
   d. *Solar chimney or wall*
   e. *Mini-wind turbines*
   f. *3-D printing and advanced construction materials for local and circular economy*
   g. *Micro-grid and Virtual Power Plant technologies to integrate local resources and collaborate with grid. Including Grid-Interactive Efficient Building (GEB) technologies*
   h. *Dynamic Thermochromic Fenestration (window) Elements Incorporating VO2 Nanoparticles, and other Chromogenic (EC or TC) Window technologies*
   i. *Camera technology and data processing for touchless access control, occupant counting, enhanced security, and all demand-based facility services, such as lighting, HVAC, and space management*
   j. *Wireless sensor networks, wireless soil-moisture sensors*
   k. *Advanced water savings technologies, equipment, and systems*
   l. *Energy and Sustainability Plan from the planning and A/E teams, including pathway and implementation plans, to be reviewed by the ACD and consultants throughout*

E. *Rebates and Incentives*
   1. *CPS/SAWS, State, and Federal and other Incentives may be available. The Design Team should seek to leverage all available programs to maximize ROI for sustainable systems.*
   2. *Incentives are offered for a variety of systems including pavements, roofs, HVAC, Electrical, Plumbing, and construction materials.*
   3. *Documentation required*
      b. *The application process differs for available incentives. The Design Team is to assist in submitting applications for the programs identified as opportunities on the project.*
      c. *Incentive programs routinely require documentation of existing systems, specifications for proposed systems, and post installation reports to show that systems were provided within the guidelines of the program. The Design Team is to assist in the gathering and submitting the required documentation.*

F. *Resources:*
   1. *CDRA Construction & Demolition Recycling Association www.cdrecycling.org*
   2. *Test, Inc. is a local salvage contractor that is in the District's system as an approved*

contractor.

3. *U.S. Green Building Council www.usgbc.org*
4. *Energy Efficiency and Conservation Block Grant Program Blueprints | Department of Energy*
5. *US DoE (Department of Energy) BTO (Building Technology Office)*
6. *US GSA GPG (Green Proving Ground) program*

END OF SECTION 00 00 00

Division 00 – Design Submission Checklists

The following checklists are to be used with section 00 00 00 to confirm compliance with the design standards at each submission.

00	00	00-01	Exhibit 01 Programing Definition
00	00	00-02	Exhibit 02 Schematic Design
00	00	00-03	Exhibit 03 Design Development
00	00	00-04	Exhibit 04 Construction Document

Division 00 – Exhibit 01
Design Submission Checklist – Project Definition

SECTION 00 00 00-01 – DESIGN SUBMISSION CHECKLIST – PROJECT DEFINITION
Alamo Colleges Project Number: Click here to enter text..
Designer Project Number: Click here to enter text..

You must indicate the following information when completing this document:

1. Page number of the plan on which the item is shown. If the item is shown on multiple pages, please list all applicable pages; or if the item is shown on an attachment, rather than the plan:
   a. For paper submissions indicate the title of the document and the page number in each area
   b. For electronic submissions, include the file name (e.g. See attached file "Equipment Manufacturer Info on Structural Loading.pdf") and the page number
2. If an entire section (e.g. "Foundation") is not applicable to the project, you must mark ALL of the Not Applicable (NA) boxes for that section.

Program of Requirements	Document Reference or Response	Not Applicable	PM Review	
Prepare a summary report containing research regarding the following		NA	Yes	No
1. Final building program (ACCD furnishes initial program)	Reference	☐	☐	☐
2. Note all spaces, people, equipment requirements, and special requirements for each space	Reference	☐	☐	☐
3. Include all equipment, furniture, layout, and special requirements for each space.	Reference	☐	☐	☐

Building Systems	Document Reference or Response	Not Applicable	PM Review	
Prepare a summary report containing research regarding the following		NA	Yes	No
1. Life cycle and performance differences in each of the different systems	Reference	☐	☐	☐

Cost Model	Document Reference or Response	Not Applicable	PM Review	
		NA	Yes	No
1. Develop a cost model that will maintain a current working estimate of total project cost that will provide ACCD and the design team with immediate feedback on design decisions	Click here to enter text.	☐	☐	☐

Division 00 – Exhibit 01
Design Submission Checklist – Project Definition

Site Investigation Analysis	Document Reference or Response	Not Applicable	PM Review	
Prepare a summary report containing research regarding the following		NA	Yes	No
1. Existing conditions	Reference	☐	☐	☐
2. Status of site survey or plat	Reference	☐	☐	☐
3. Easements	Reference	☐	☐	☐
4. Existing utilities and locations	Reference	☐	☐	☐
5. Existing Fire hydrants and future requirements	Reference	☐	☐	☐
6. Existing drainage and drainage issues	Reference	☐	☐	☐
7. Existing soils / geology	Reference	☐	☐	☐
8. Parking requirements	Reference	☐	☐	☐
9. Traffic impact. Determine if analysis is required	Reference	☐	☐	☐

Building Investigation Analysis	Document Reference or Response	Not Applicable	PM Review	
Prepare a summary report containing research regarding the following		NA	Yes	No
1. Existing building conditions including structural systems, mechanical systems, electrical systems, and architectural components	Reference	☐	☐	☐
2. Existing building documentation from ACCD, including all original and any renovation construction documents and CADD files if available	Reference	☐	☐	☐
3. Special assessments from ACCD that have been performed on existing buildings such as structural, acoustical etc.	Reference	☐	☐	☐
4. Historic restrictions. Obtain any documentation from ACCD	Reference	☐	☐	☐
5. View corridor issues	Reference	☐	☐	☐
6. Zoning requirements/restrictions, including building uses, height limits	Reference	☐	☐	☐
7. Code requirements for building type	Reference	☐	☐	☐

Division 00 – Exhibit 01
Design Submission Checklist – Project Definition

Conceptual Design	Document Reference or Response	Not Applicable	PM Review	
		NA	Yes	No
1. Develop a design that illustrates the overall concept.	Reference	☐	☐	☐
2. Plans indicating site concepts	Reference	☐	☐	☐
3. Buildings on the site	Reference	☐	☐	☐
4. Spaces in the buildings, by floor	Reference	☐	☐	☐
5. Key elevations	Reference	☐	☐	☐
6. Narrative describing structural system	Reference	☐	☐	☐
7. Narrative describing MEP systems	Reference	☐	☐	☐
8. Narrative describing civil design	Reference	☐	☐	☐
9. Narrative describing landscape design	Reference	☐	☐	☐
10. Narrative describing architectural design	Reference	☐	☐	☐
11. Meeting minutes	Reference	☐	☐	☐

Process Definition	Document Reference or Response	Not Applicable	PM Review	
		NA	Yes	No
1. Define Process of Project Definition, including work sessions and meeting requirements, and who is required at each work session	Reference	☐	☐	☐
2. Define with ACCD who the decision makers are for the project. If there are several, define those and who has ultimate authority	Reference	☐	☐	☐
3. Establish decision and approval processes for all phases from Project Definition through Construction Documentation	Reference	☐	☐	☐
4. Establish decision and approval process for Construction Change Orders	Reference	☐	☐	☐
5. Define project schedule.	Reference	☐	☐	☐

END OF SECTION 00 00 00-01

Division 00 – Exhibit 02
Design Submission Checklist – Schematic Design

SECTION 00 00 00-02 – DESIGN SUBMISSION CHECKLIST – SCHEMATIC DESIGN
Alamo Colleges Project Number: Click here to enter text.
Designer Project Number: Click here to enter text.

You must indicate the following information when completing this document:

1. Page number of the plan on which the item is shown. If the item is shown on multiple pages, please list all applicable pages; or if the item is shown on an attachment, rather than the plan:
   a. For paper submissions indicate the title of the document and the page number in each area
   b. For electronic submissions, include the file name (e.g. See attached file "Equipment Manufacturer Info on Structural Loading.pdf") and the page number
2. If an entire section (e.g. "Foundation") is not applicable to the project, you must mark ALL of the Not Applicable (NA) boxes for that section.

Architectural	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Refinement of site plan at scale to illustrate building, parking lot layout, site features, adjacent structures, and access to site. (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Relationship of all proposed work to existing site and/or building features illustrated	Reference	☐	☐	☐
3. Demolition plan indicating extent of demolition (if needed).	Reference	☐	☐	☐
4. Building layout showing all spaces required	Reference	☐	☐	☐
5. Reflected ceiling plans indicating lighting and special ceiling features	Reference	☐	☐	☐
6. Roof plan	Reference	☐	☐	☐
7. Building elevations, basic building sections, and wall sections shall be illustrated	Reference	☐	☐	☐
8. Major interior features shall be illustrated through enlarged plans and elevations	Reference	☐	☐	☐
9. Outline specifications for each category of proposed work	Reference	☐	☐	☐
10. Finish materials developed and presented	Reference	☐	☐	☐
11. Gross square footage and area calculations	Reference	☐	☐	☐
12. Code analysis, indicating building classifications, occupancy, interpretations, and special requirements	Reference	☐	☐	☐

13. Rendering or model if needed and authorized based on scope of work	Reference	☐	☒	☐
14. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Structural	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Structural drawings indicating foundation design and structural framing system	Reference	☐	☐	☐
2. Outline specifications for each category of proposed work	Reference	☐	☐	☐
3. Narrative of the structural systems: reinforced concrete, structural steel, combination frame, floor system, and stress distribution.	Reference	☐	☐	☐
4. Indicate the method of analysis and design: pre-cast or cast-in-place concrete, bolted or field-welded structural steel, etc.	Reference	☐	☐	☐
5. Calculations developed for proposed use	Reference	☐	☐	☐
6. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Mechanical and Plumbing	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Site Plan(s) at a scale consistent with architectural site plan showing location of existing utilities and site requirements (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Floor plans indicating mechanical rooms, equipment layout and single line duct and pipe routes.	Reference	☐	☐	☐
3. Plumbing fixtures and equipment (this may be shown on architectural floor plan)	Reference	☐	☐	☐

4. Preliminary equipment schedules indicating proposed flow rates, capacities, selections, and the building schedule filled out completely	Reference	☐	☐	☐
5. Outline specifications for each category of proposed work	Reference	☐	☐	☐
6. Narrative describing proposed system, controls, gross design loads, supply and return air system, principal piping materials, and fire protection	Reference	☐	☐	☐
7. Initial selection of all major mechanical and plumbing equipment. Provide cut sheets of equipment	Reference	☐	☐	☐
8. Life Cycle Costs developed, if requested by the owner	Reference	☐	☐	☐
9. Initial code analysis including plumbing fixtures quantity requirements by code	Reference	☐	☐	☐
10. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Electrical	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Site Plan(s) at scale consistent with Architectural Site Plan showing electrical service location and characteristics, sub-stations, vaults etc. (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Demolition plans if required indicating existing system and lighting, and include fixtures to be removed	Reference	☐	☐	☐
3. Floor plans indicating electrical rooms, equipment layout, lighting layout, panel locations, electrical rooms, telephone, and data rooms.	Reference	☐	☐	☐
4. Typical lighting in all areas indicated	Reference	☐	☐	☐
5. Rough, one-line or riser diagram	Reference	☐	☐	☐
6. Typical capacities and sizes shown where available	Reference	☐	☐	☐
7. Preliminary equipment and lighting schedules	Reference	☐	☐	☐

8. Outline specifications for each category of proposed work	Reference	☐	☐	☐
9. Initial selection of all major electrical equipment and lighting	Reference	☐	☐	☐
10. Schematic design of load analysis	Reference	☐	☐	☐
11. Life Cycle Costs shall be developed if requested by the owner	Reference	☐	☐	☐
12. Code analysis. All existing code deficiencies shall be indicated. A method of correction shall be recommended and an estimate of the cost of that recommendation shall be included	Reference	☐	☐	☐
13. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Civil	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Site plan(s) at scale consistent to convey design concept (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Site utilities illustrated and identified.	Reference	☐	☐	☐
3. Major civil engineering elements illustrated to convey site design concept	Reference	☐	☐	☐
4. Vehicular and pedestrian circulation layout illustrated	Reference	☐	☐	☐
5. Relationship of all proposed work to existing site survey illustrated	Reference	☐	☐	☐
6. Outline specifications for each category of proposed work	Reference	☐	☐	☐
7. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Landscape Architecture	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No

1. Site plan(s) at scale consistent to convey design concept (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Relationships of all proposed work to existing site features.	Reference	☐	☐	☐
3. Site concept including trees, walls, fences, planting areas, and special site features to convey overall site design	Reference	☐	☐	☐
4. Indication of areas to receive landscape irrigation with water source located	Reference	☐	☐	☐
5. Vehicular and pedestrian circulation layout illustrated	Reference	☐	☐	☐
6. Site improvements including furnishings and signage indicated	Reference	☐	☐	☐
7. Outline specifications for each category of proposed work.	Reference	☐	☐	☐
8. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Process Documents	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Meeting minutes	Reference	☐	☐	☐
2. Updated project schedule	Reference	☐	☐	☐

END OF SECTION 00 00 00-02

Division 00 – Exhibit 03
Design Submission Checklist – Design Development

SECTION 00 00 00-03 – DESIGN SUBMISSION CHECKLIST – DESIGN DEVELOPMENT
Alamo Colleges Project Number: Click or tap here to enter text.
Designer Project Number: Click or tap here to enter text.

You must indicate the following information when completing this document:

1. Page number of the plan on which the item is shown. If the item is shown on multiple pages, please list all applicable pages; or if the item is shown on an attachment, rather than the plan:
    a. For paper submissions indicate the title of the document and the page number in each area
    b. For electronic submissions, include the file name (e.g. See attached file "Equipment Manufacturer Info on Structural Loading.pdf") and the page number
2. If an entire section (e.g. "Foundation") is not applicable to the project, you must mark ALL of the Not Applicable (NA) boxes for that section.

Architectural	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Refinement of site plan at scale to illustrate building, parking lot layout, site features, adjacent structures, and access to site. (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Refinement of demolition plan indicating extent of demolition (if needed)	Reference	☐	☐	☐
3. Refinement of building floor plans indicating overall dimensions, room titles and numbers, door swings, furniture layouts, equipment layout, and fire-rated walls	Reference	☐	☐	☐
4. Refinement of reflected ceiling plans indicating lighting and special ceiling features	Reference	☐	☐	☐
5. Refinement of roof plans indicating overall dimensions and slopes	Reference	☐	☐	☐
6. Exterior elevations indicating all openings, dimensions, special features, etc.	Reference	☐	☐	☐
7. Building and wall sections	Reference	☐	☐	☐
8. Interior or exterior features illustrated in enlarged plans, elevations, and details as needed to convey design	Reference	☐	☐	☐
9. Door schedule, finish schedule, and partition types to be developed	Reference	☐	☐	☐
10. Specifications written to match the scope of work	Reference	☐	☐	☐

11. Accessible routes shall be identified that meet ADA requirements	Reference	☐	☒	☐
12. Finish material selections finalized	Reference	☐	☐	☐
13. Cut sheets illustrating proposed systems, materials and equipment	Reference	☐	☐	☐
14. Gross square footage and area calculations	Reference	☐	☐	☐
15. Code analysis finalized, indicating building classifications, occupancy, interpretations, and special requirements	Reference	☐	☐	☐
16. Rendering or model if needed and authorized based on scope of work	Reference	☐	☐	☐
17. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Structural	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Foundation plan indicating dimensions	Reference	☐	☐	☐
2. Floor plans indicating column spacing dimensions, column sizes, beam sizes, and floor framing	Reference	☐	☐	☐
3. Building sections showing floor elevations	Reference	☐	☐	☐
4. Typical sectional details	Reference	☐	☐	☐
5. Structural design for special features	Reference	☐	☐	☐
6. Specifications written to match the scope of work	Reference	☐	☐	☐
7. Calculations for live loads of floor, roof, wind, impact, vibration and other special requirements	Reference	☐	☐	☐
8. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Mechanical and Plumbing	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Refinement of site plan(s) at scale consistent with the Architectural site plan showing existing and proposed utilities, (underground and overhead with sizes, valves, boxes, cleanouts, access ways, and manholes indicated), fire protection Siamese and hydrant locations	Reference	☐	☐	☐
2. Refinement of HVAC plans indicating:				
a. HVAC equipment (air handlers, pumps, compressors, etc. shown to scale with clearances indicated including coil pull space for A/C units)	Reference	☐	☐	☐
b. Medium pressure ductwork shown in double line format, placement of single/dual terminal units, and thermostats. Show major taps, splits, and duct sizes	Reference	☐	☐	☐
c. Low pressure ductwork shown in single line format, not sized. Diffusers, grilles, and returns shown but not sized	Reference	☐	☐	☐
d. Above ceiling space detail, cross-section and/or other appropriate drawing method to convey requirements for specific services such as special laboratory services, conduit, piping, ductwork, fire protection piping etc.	Reference	☐	☐	☐
e. Equipment schedules	Reference	☐	☐	☐
3. Refinement of plumbing plans indicating:				
a. Plumbing fixtures, floor and roof drains, special devices	Reference	☐	☐	☐
b. Soil, waste and vent piping and main supply taps and piping sized	Reference	☐	☐	☐
c. Typical riser diagrams	Reference	☐	☐	☐

d. Special plumbing system requirements such as vacuum, compressed air de-ionized water, medical or laboratory gases	Reference	☐	☐	☐
e. Equipment and plumbing schedules	Reference	☐	☐	☐
4. Fire protection plans indicating:				
a. Location of incoming supply, valves, fire pump, etc.	Reference	☐	☐	☐
b. Piping routes, sprinkler head locations in architecturally sensitive areas only, and fire department connections	Reference	☐	☐	☐
c. Sizes of risers and trunks	Reference	☐	☐	☐
5. Specifications written to match the scope of work	Reference	☐	☐	☐
6. Narrative and special environmental requirements such as equipment, space pressurization, processes, animals, odors, sterility, etc.	Reference	☐	☐	☐
7. Code analysis finalized including plumbing fixtures quantity requirements by code	Reference	☐	☐	☐
8. Design loads for HVAC and plumbing	Reference	☐	☐	☐
9. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Electrical	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Refinement of site plan and floor plans(s) at a scale consistent with architectural site plan showing electrical service location and characteristics, sub-stations, vaults etc. (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Refinement of demolition plans, if required, indicating existing system and lighting. All lighting and electrical systems being kept or removed shall be indicated	Reference	☐	☐	☐

3. Refinement of floor plans indicating electrical rooms, equipment layout, lighting layout, panel locations, electrical rooms, telephone, and data rooms	Reference	☐	☐	☐
4. Refinement of lighting, panel, and equipment schedules	Reference	☐	☐	☐
5. Schedule of all rooms with maintained foot candle levels	Reference	☐	☐	☐
6. Specifications written to match the scope of work	Reference	☐	☐	☐
7. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Civil	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Refinement of site drawing(s) at a scale consistent with Architectural Site Plan, including scale, graphic scale, and north arrow	Reference	☐	☐	☐
2. Site plan illustrating complete scope of engineered features	Reference	☐	☐	☐
3. Site plan illustrating complete scope of outdoor lighting if within consultant's scope of work	Reference	☐	☐	☐
4. Hardscape materials within scope of civil work identified	Reference	☐	☐	☐
5. Temporary storm water runoff and containment to meet applicable standards illustrated	Reference	☐	☐	☐
6. Specifications written to match the scope of work	Reference	☐	☐	☐
7. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Landscape Architecture	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No

1. Refinement of site plan(s) at scale selected to convey the design (including scale, graphic scale, and north arrow)	Reference	☐	☐	☐
2. Site plan illustrating complete scope of all landscape architectural elements including hardscape elements, site lighting, and hardscape materials	Reference	☐	☐	☐
3. Grading plan indicating existing and proposed grades	Reference	☐	☐	☐
4. Plant materials identified and illustrated on a site plan	Reference	☐	☐	☐
5. Generally develop the irrigation plan to illustrate provision of coverage, and types of components (sprays on risers, pop- up sprays, rotary, drip systems, etc.)	Reference	☐	☐	☐
6. Specifications written to match the scope of work	Reference	☐	☐	☐
7. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Process Documents	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Meeting minutes	Reference	☐	☐	☐
2. Updated project schedule	Reference	☐	☐	☐

END OF SECTION 00 00 00-03

Division 00 – Exhibit 04
Design Submission Checklist – Construction Document

SECTION 00 00 00-04 – DESIGN SUBMISSION CHECKLIST – CONSTRUCTION DOCUMENTS
Alamo Colleges Project Number: Click or tap here to enter text.
Designer Project Number: Click here to enter text.
Construction Document Submission Stage:

You must indicate the following information when completing this document:

1. Page number of the plan on which the item is shown. If the item is shown on multiple pages, please list all applicable pages; or if the item is shown on an attachment, rather than the plan:
   a. For paper submissions indicate the title of the document and the page number in each area
   b. For electronic submissions, include the file name (e.g. See attached file "Equipment Manufacturer Info on Structural Loading.pdf") and the page number
2. If an entire section (e.g. "Foundation") is not applicable to the project, you must mark ALL of the Not Applicable (NA) boxes for that section.

The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following

Architectural	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.	Click here to enter text.	☐	☐	☐
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated	Reference	☐	☐	☐
3. Alternates, if any, shall be clearly written in documentation	Reference	☐	☐	☐
4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Architect, including date of expiration of current license	Reference	☐	☐	☐
5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager	Reference	☐	☒	☐

6. Drawings shall also be submitted to the Texas Accessibility Reviewer as required by TAS rules	Reference	☐	☐	☐
7. Rendering or model, if needed, and authorized based on scope of work	Reference	☐	☐	☐
8. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Structural	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.	Reference	☐	☐	☐
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated	Reference	☐	☐	☐
3. Alternates, if any, shall be clearly written in documentation	Reference	☐	☐	☐
4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Structural Engineer, including date of expiration of current license	Reference	☐	☐	☐
5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager	Reference	☐	☐	☐
6. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Mechanical and Plumbing	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No

1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation	Reference	☐	☐	☐
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated				
3. Alternates, if any, shall be clearly written in documentation	Reference	☐	☐	☐
4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Mechanical Engineer, including date of expiration of current license	Reference	☐	☐	☐
5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager	Reference	☐	☐	☐
6. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Electrical	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation	Reference	☐	☐	☐
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated	Reference	☐	☐	☐
3. Alternates, if any, shall be clearly written in documentation	Reference	☐	☐	☐
4. Refinement of lighting, panel, and equipment schedules	Reference	☐	☐	☐

5. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Electrical Engineer, including date of expiration of current license	Reference	☐	☐	☐
6. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager	Reference	☐	☐	☐
7. Energy analysis shall be documented	Reference	☐	☐	☐
8. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Civil	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal should be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.	Reference	☐	☐	☐
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated	Reference	☐	☐	☐
3. Alternates, if any, shall be clearly written in documentation	Reference	☐	☐	☐
4. Upon completion of the final submittal, the documents (drawings and specifications) should include a dated and signed seal of the State of Texas licensed Civil Engineer, including date of expiration of current license	Reference	☐	☐	☐
5. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions	Reference	☐	☐	☐

Landscape Architecture	Document Reference or Response	Not Applicable	PM Review

Division 00 – Exhibit 04
Design Submission Checklist – Construction Document

Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal should be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation	Reference	☐	☐	☐
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated	Reference	☐	☐	☐
3. Alternates, if any, shall be clearly written in documentation	Reference	☐	☐	☐
4. Upon completion of the final submittal, the documents (drawings and specifications) should include a dated and signed seal of the State of Texas-licensed Landscape Architect. Landscape irrigation drawings and specifications shall include the dated and signed seal of the State of Texas- licensed Landscape Irrigator	Reference	☐	☐	☐
5. The Landscape Architect shall prepare the Tree Preservation Plan and Tree Affidavit form, required as part of the building permit process	Reference	☐	☐	☐
6. Cost estimate of the work. This cost estimate shall describe the work and clearly define inclusions and exclusions.	Reference	☐	☐	☐

Process Documents	Document Reference or Response	Not Applicable	PM Review	
Prepare drawings, specifications or reports for the following		NA	Yes	No
1. Meeting minutes	Reference	☐	☐	☐
2. Updated project schedule	Reference	☐	☐	☐

END OF SECTION 00 00 00-04

SECTION 00 00 01 – PROGRAMING DEFINITION

PART 1 - General

1.1 After award of the contract by ACCD the design team will begin Programing Definition, which is the process of understanding and documenting ACCD's requirements for the project: the values, goals, strategies, and detailed requirements—for both process and product—and then establishing the scope that can be delivered within the constraints of cost, schedule, and quality

1.2 ACCD has established **Educational Standards** and **Design and Construction Standards** that will be a guide for the design professional to help through the decision making process. These standards should be thoroughly reviewed when design concepts, layouts, and product selections are developed as these standards are required by ACCD in the implementation of the design.

1.3 During Programing Definition, early discovery of ACCD's values sets ideas that will guide design thought. Designs that respond to specific programmatic needs and express the values of the institution are the natural result of this process. Values, reflected by programmatic content, standards and procedures, established by the stakeholders, become a filter for future decisions. Those help the team meet the design objectives and minimize costly changes as the project progresses.

PART 2 - Workshop / Big Picture Concepts

2.1 To perform the Programing Definition task with ACCD, the design team will utilize a workshop format that will provide an opportunity for collaboration and buy-in for all parties. The Big Picture concepts to be discussed as part of the workshop are the values, goals, and strategies for the project, and the overall process. The workshop should include:

A. Facilities Department ACCD

B. User Group

C. Architect / Designer

D. Structural Engineer (as needed)

E. MEP Engineer (as needed)

F. Civil Engineer (as needed)

G. Landscape Architect (as needed)

H. Other Consultants (as needed)

PART 3 - Site and Building Investigation Analysis

3.1 It is critical to perform a full site and building analysis early in the project. Discovering site and building issues early will help in the decision-making process during the programing definition phase, and eliminate rework of documentation based on poor uninformed decisions. The analysis should include:

A. Site Investigation Analysis
1. Researching existing site conditions.
2. Determining if the site has been surveyed or platted. If not the owner is responsible for obtaining these services.
3. Identifying easements.
4. Identifying existing utilities and underground utility locations.
5. Identifying existing fire hydrants and determining fire hydrant requirements.
6. Identifying existing drainage and any drainage issues.
7. Researching existing soils / geology. The geotechnical report is the responsibility of the owner.
8. Determining if there is any cultural restrictions (archaeological or wildlife sites). Obtain any documentation from ACCD.
9. Identifying parking requirements.
10. Researching traffic impact. Determine if a traffic analysis is required, and obtain through ACCD.

B. Building Investigation Analysis
1. Researching existing building conditions including structural systems, mechanical systems, electrical systems, and architectural components
2. Obtain all existing building documentation from ACCD, including all original and any renovation construction documents and CADD files if available.
3. Obtain any special assessments from ACCD that have been performed on existing buildings such as structural, acoustical etc. identifying hazardous materials. Obtain reports from owner, and notify owner of any suspicious materials, including organic growth, if a report is not available.
4. Determining if there is any Historic restrictions. Obtain any documentation from ACCD.
5. Determining if there are any view corridor issues.
6. Verifying zoning requirements/restrictions, including building uses, height limits.

7. Researching code requirements for building type

PART 4 - Develop and/or Finalize Program.

4.1 In many cases ACCD will already have a program developed for the project.

A. If a program has not been developed, the design team shall set up meetings with all departments within the user group to define requirements. Note all spaces, people, equipment requirements, and special requirements for each space. Use the educational standards as your guide for the space requirements.

B. If a program has already been developed, the program shall be reviewed by the team. Meetings should be organized to confirm and/or update the program requirements as needed. In many cases more detailed programming will be required to include all equipment, furniture, layout, and special requirements for each space.

PART 5 - Develop Building Systems

5.1 A spectrum of building systems should be developed and priced. The design team will need to describe the life cycles and define the performance differences for each of the different systems.

5.2 The design team should develop an understanding of the cost/benefit criteria (ACCD's definition of "value") to help guide an analysis and to define the quality.

5.3 The analysis should be reviewed with ACCD for a final direction based on value.

5.4 The decision logic and the approval mechanisms to be documented.

PART 6 - Develop Cost Model

6.1 A cost model will be developed that will maintain a current working estimate of total project cost that will provide ACCD and the design team with immediate feedback on design decisions.

6.2 The effect of related decisions should be defined.

PART 7 - Conceptual Design

7.1 A design that illustrates the overall concept will be developed by the design professionals. For a building or renovation, this will include plans indicating site concepts, buildings, spaces, and key elevations. Narratives should be written describing the structural system, MEP systems, and civil, landscape, and architectural concepts.

7.2 Through a work session with ACCD, the user groups, and the design team, concepts and alternatives should be discussed; including how comments may be worked into design.

PART 8 - Process Definition

8.1 The process for the overall project shall be defined as described:

A. Define Process of Programing Definition, including work sessions and meeting requirements, and who is required at each work session.

B. Define with ACCD who the decision makers are for the project. If there are several, define those and who has ultimate authority.

C. Establish decision and approval processes for all phases from Programing Definition through Construction Documentation.

D. Establish decision and approval process for Construction Change Orders.

E. Define project schedule. Update throughout the process. Schedule to include:
1. Project Definition Workshops
2. Programming
3. Conceptual Design
4. ACCD Review and Approval
5. Schematic Design
6. Cost Estimating
7. ACCD Review and Approval
8. Design Development
9. Cost Estimating

10. ACCD Review and Approval
11. Construction Documentation – 65%
12. ACCD Review and Approval
13. Construction Documentation – 98%
14. ACCD Review and Approval
15. Construction Documentation – 100%
16. Solicitation for Construction Contracting
17. Estimated Construction Mobilization
18. Substantial Completion
19. Warranty Period

PART 9 - Reference Exhibits

9.1 Refer to 00 00 00-01 for Exhibit 01 Design Submission Checklist

END OF SECTION 00 00 01

SECTION 00 00 02 – ARCHITECTURAL REQUIREMENTS

PART 1 - General

1.1 The Architect / design professional shall participate in all work sessions, reviews, and presentations; and work in conjunction with all other design professionals to provide integrated documentation. ACCD will participate in the project during Programing Definition through Substantial Completion and will approve work performed by design professionals at the scheduled periods.

PART 2 - Design Scope

2.1 The architectural design shall consist of, but not be limited to the following:

A. Siting (designed in coordination with Civil Engineer and Landscape Architect)

B. Site design including features such as plazas, courtyards, etc. (designed in coordination with Landscape Architect)

C. Building design and interior design concepts

D. Layout of all interior spaces

E. Door and window schedule, partition types, elevations, building sections, and wall sections.

F. Building material and finish selections

G. Lighting design (designed in coordination with Electrical Engineer)

PART 3 - Submittal Requirements

3.1 The following are general requirements for submittals.

A. The Educational Standards and Design and Construction Standards are to be used as a basis for the design. The Architect is responsible for writing the specifications for the specific project. The Design and Construction Standards are not specifications, and may not be reproduced as such.

B. The Architect shall work in conjunction with the other design professionals in developing the design and documentation to assure that all documents are coordinated.

C. The Architect shall submit drawings, and specifications for review by ACCD at designated intervals. Intermediate reviews may be required if the scope of the project has been changed, if an earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was not accepted by ACCD in whole or in part.

D. Any submittal comments received from ACCD, that the Architect cannot incorporate based on professional practice or due to project constraints, shall be responded to in writing to ACCD's project manager as early as practical but prior to the next submittal.

E. All architectural drawings and specifications shall bear the responsible Architect's name and registration number, address, telephone and fax numbers. It is not necessary to seal documents at all stages of the design. All items submitted shall be in compliance with the Texas Board of Architectural Examiners (TBAE) regarding signatures and use of the architectural seal.

F. The Architect shall use ACCD's standard title block and set up drawings as agreed with the manager of the design team.

G. The ACCD project number shall be included in the title block, specifications and other contract documents.

H. Schedule
   1. Prepare a schedule for the performance of services through the following milestones and submit at each project phase submittal:
      a. Programing Definition
      b. Schematic Design
      c. Design Development
      d. Construction Documents
      e. Contractor procurement
      f. Construction
      g. Occupancy/use
      h. Closeout

PART 4 - Programing Definition

4.1 The Programing Definition Phase includes several components. The Architect will work in coordination with the other design professionals and be involved in the Programing Definition phase as indicated below.

A. Workshop
   1. The Architect should lead discussions on values, goals, and strategies; and be involved in all discussion regarding site and building concepts.

B. Site and Building Analysis

1. The Architect shall research all relevant site and building issues, in coordination with the other design professionals, as outlined in the Programing Definition section of these standards.

C. Program
1. The Architect will be responsible for developing or refining the program and meet with all user groups to define needs. The Architect will obtain input from other consultants as needed.
2. The manager of the design team will submit the program for review and approval by ACCD.

D. Building Systems Developed
1. The Architect will develop concepts of the building and building systems in conjunction with the MEP and Structural Engineers. Differences in performance of the options shall be identified.
2. The design team will review concepts with ACCD for approval.

E. Conceptual Design
1. The Architect will be responsible for developing building, renovation, and site conceptual designs.
2. The site design shall include building siting, major circulation, and special features (developed in conjunction with the Landscape Architect and the Civil Engineer).
3. Building design and/or renovations shall illustrate the building concept showing all major spaces and circulation (developed in conjunction with MEP and Structural Engineers).
4. A brief narrative shall be written describing the scope and character of the building and site. Special features and the initial concept of finish materials shall be described.

F. Cost Estimate
1. If required as part of scope of work, the Architect will prepare a cost estimate of architectural work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 5 - Schematic Design

5.1 Based on approval of the Programing Definition components, the Schematic Design submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications
1. Refinement of site plan at scale to illustrate building, parking lot layout, site features, adjacent structures, and access to site. (including scale, graphic scale, and north arrow)
2. Relationship of all proposed work to existing site and/or building features illustrated.
3. Demolition plan indicating extent of demolition (if needed).
4. Building layout showing all spaces required.
5. Reflected ceiling plans indicating lighting and special ceiling features.

6. Roof plan.
7. Building elevations, basic building sections, and wall sections shall be illustrated.
8. Major interior features shall be illustrated through enlarged plans and elevations.
9. Outline specifications for each category of proposed work.

B. Other
1. Finish materials developed and presented. Options on finish materials may be needed by the user groups.
2. Gross square footage and area calculations.
3. Code analysis, indicating building classifications, occupancy, interpretations, and special requirements.
4. Rendering or model if needed and authorized based on scope of work.

C. Cost Estimate
1. If required as part of scope of work, the Architect will prepare a cost estimate of architectural work. This cost estimate shall describe work and clearly define inclusions, and exclusions.

PART 6 - Design Development

6.1 The Design Development submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications
1. Refinement of site plan(s) illustrating all building and site features, worked in conjunction with Landscape and Civil Engineer (including scale, graphic scale, and north arrow).
2. Refinement of demolition plan indicating extent of demolition (if needed).
3. Refinement of building floor plans indicating overall dimensions, room titles and numbers, door swings, furniture layouts, equipment layout, and fire-rated walls.
4. Refinement of reflected ceiling plans indicating lighting and special ceiling features.
5. Refinement of roof plans indicating overall dimensions and slopes.
6. Exterior elevations indicating all openings, dimensions, special features, etc.
7. Building and wall sections.
8. Interior or exterior features illustrated in enlarged plans, elevations, and details as needed to convey design.
9. Door schedule, finish schedule, and partition types to be developed.
10. Specifications written to match the scope of work.
11. Accessible routes shall be identified that meet ADA requirements.

B. Other
1. Finish material selections finalized.
2. Cut sheets illustrating proposed systems, materials and equipment.

3. Gross square footage and area calculations.
4. Code analysis finalized, indicating building classifications, occupancy, interpretations, and special requirements.
5. Rendering or model if needed and authorized based on scope of work.

C. Cost Estimate
1. If included in the scope of work, the Architect will prepare a cost estimate of architectural work. This cost estimate shall describe work and clearly define inclusions, and exclusions.

PART 7 - Construction Documents

7.1 The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following:

A. Drawings / Specifications
1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated.
3. Alternates, if any, shall be clearly written in documentation.
4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Architect, including date of expiration of current license.
5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager.
6. Drawings shall also be submitted to the Texas Accessibility Reviewer as required by TAS rules.

B. Other
1. Rendering or model, if needed, and authorized based on scope of work.

C. Cost Estimate
1. If required as part of the scope of work, the Architect will prepare a cost estimate of architectural work. This cost estimate shall describe work and clearly define inclusions, and exclusions.

PART 8 - Solicitation for Construction Contracting

8.1 The Architect shall respond to bidding questions as needed and as directed by the manager of the design team. The Architect will also assist in evaluating, grading, and ranking proposals with regard to the architectural components of the bid, as directed by ACCD's project manager.

PART 9 - Construction Administration

9.1 The Architect shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work, and respond to requests as appropriate to the scope of work and in coordination with the manager of the design team. Responsibilities will include:

a. Process submittals as directed by the manager of the design team.
b. Respond to Requests for Information (RFI's) and write Proposal Requests (PR), and Architectural Supplemental Instructions (ASI) as directed by the manager of the design team.
c. Evaluate contractor's change proposals as directed by the manager of the design team and make recommendations.
d. Attend project meetings and visit the project site as determined by ACCD's project manager and the manager of the design team.

PART 10 - Substantial Completion

10.1 The Architect shall develop a punch list for the architectural components of the project at the time of substantial completion as agreed to by ACCD's project manager and the contractor. Punch list to be submitted to the manager of the design team, who will in turn submit to ACCD's project manager and the contractor.

PART 11 - Warranty Period

11.1 The Architect will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contractor may request additional services for review and professional opinions from the Architect.

PART 12 - Project Notebook

12.1 A Project Notebook shall be kept for each project and be available for review by ACCD, the manager of the design team, and/or the ACCD project manager. Project Notebooks will include all information pertinent to the design of the project.

A. It shall include but may not be limited to the following dividers and information:
1. Design criteria
2. Meeting notes
3. Correspondence (letters, transmittals, etc.)
4. Code reviews
5. Cost estimates
6. Material and product selection cut sheets.
7. Specification information Miscellaneous

END OF SECTION 00 00 02

SECTION 00 00 03 – STRUCTURAL ENGINEERING REQUIREMENTS

PART 1 - General

1.1 The Structural Engineer / design professional shall participate in all work sessions, reviews, and presentations; and work in conjunction with all other design professionals to provide integrated documentation. ACCD will participate in the project during Programing Definition through Substantial Completion and will approve work performed by design professionals at scheduled periods.

PART 2 - Design Scope

2.1 The structural design shall consist of, but not be limited to the following:

A. Structural engineered drawings for the building structural system and site requirements.
   1. Future loads – structures built for ACCD must be designed to accept future loads large enough to permit wide flexibility in their functions. Refer to load requirements described in the standards.
   2. Load reductions – ACCD structures are subject to increased loads and high sustained live loads. Loads are often applied to large areas of usable floor space (thereby making liberal live load reduction factors undesirable).
   3. Deflection – live loads and deflection limitations must be assumed to accommodate these conditions of design. Care must be exercised in control of immediate and long-time deflections to prevent immediate and future damage to non-structural elements attached to the structure.

B. Structural integrity – The structural system selected shall be adequately described and detailed such that all parts of the facility are incorporated and connected with the structure to allow the facility to function as a unit under extreme service conditions.

PART 3 - Submittal Requirements

3.1 The following are general requirements for submittals:

3.2 The Design and Construction Standards are to be used as a basis for the design. The Structural Engineer is responsible for writing the specifications for the specific project. These standards are not specifications, and may not be reproduced as such.

A. The Structural Engineer shall work in conjunction with the other design professionals in developing the design and documentation to assure that all documents are coordinated.

B. The Structural Engineer shall submit drawings, specifications, and calculations for review to ACCD at designated intervals. Intermediate reviews may be required if the scope of the project has been changed, if an earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was not accepted by ACCD in whole or in part.

C. Any submittal comments received from ACCD, that the Structural Engineer cannot incorporate based on professional practice or due to project constraints, shall be responded to in writing to ACCD's project manager as early as practical but prior to the next submittal.

D. All structural engineering drawings and specifications shall bear the responsible Structural Engineer's name and registration number, address, telephone and fax numbers. It is not necessary to seal documents at all stages of the design. Refer to the Texas Engineering Practice Act. All items submitted shall be in compliance with the Texas Engineering Practice Act, rule 138.138(8) regarding signatures and engineering seals.

E. The Structural Engineer shall use ACCD's standard title block and set up drawings as agreed to with the manager of the design team.

F. The ACCD project number shall be included in the title block, specifications and other contract documents.

G. Schedule
   1. Prepare a schedule for the performance of services through the following milestones and submit at each project phase submittal:
      a. Programing Definition
      b. Schematic Design
      c. Design Development
      d. Construction Documents
      e. Contractor procurement
      f. Construction
      g. Occupancy/use
      h. Closeout

PART 4 - Programing Definition

4.1 The Programing Definition Phase includes several components. The Structural Engineer will work in coordination with the other design professionals and be involved in the Programing Definition phase as indicated below.

A. Workshop

1. The Structural Engineer to be included in any discussions regarding building structural systems.

B. Site / Building Analysis
1. The Structural Engineer shall research all relevant site and building issues, in coordination with the other design professionals, as outlined in the Programing Definition section of these standards.

C. Program
1. The Structural Engineer will give input to the Program as needed. The manager of the design team will submit the program for review and approval by ACCD.

D. Building Systems Developed
1. The Structural Engineer will develop structural concepts of the building and building systems in conjunction with the Architect and MEP Engineers. Differences in performance of the options hall be identified.
2. The design team will review concepts with ACCD for approval.

E. Conceptual Design
1. The Structural Engineer will be responsible for the building structural conceptual design, including drawings that illustrate structural systems (developed in conjunction with the Architect).
2. A brief narrative of the scope of work shall be written describing the foundation and framing systems.

F. Cost Estimate
1. If required as part of scope of work, the Structural Engineer will prepare a cost estimate of structural work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 5 - Schematic Design

5.1 Based on approval of the Programing Definition components, the Schematic Design submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications
1. Structural drawings indicating foundation design and structural framing system.
2. Outline specifications for each category of proposed work.

B. Other
1. Narrative of the structural systems: reinforced concrete, structural steel, combination frame, floor system, and stress distribution. The Structural Engineer shall also indicate the

method of analysis and design: pre-cast or cast-in-place concrete, bolted or field-welded structural steel, etc.

2. Calculations developed for proposed use.

C. Cost Estimate

1. If required as part of scope of work, the Structural Engineer will prepare a cost estimate of structural work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 6 - Design Development

6.1 The Design Development submittal shall incorporate review comments from both ACCD and the ACCD's project manager. The submittal shall be developed in coordination with the other design professionals and will include the following:

A. Drawings / Specifications

1. Foundation plan indicating dimensions.
2. Floor plans indicating column spacing dimensions, column sizes, beam sizes, and floor framing.
3. Building sections showing floor elevations.
4. Typical sectional details.
5. Structural design for special features.
6. Specifications written to match the scope of work.

B. Other

1. Calculations for live loads of floor, roof, wind, impact, vibration and other special requirements.

C. Cost Estimate

1. If included in the scope of work, the Structural Engineer will prepare a cost estimate of structural work. This cost estimate shall describe work and clearly define inclusions, and exclusions.

PART 7 - Construction Documents

7.1 The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following:

A. Drawings / Specifications

1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.
2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated.
3. Alternates, if any, shall be clearly written in documentation.
4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Structural Engineer, including date of expiration of current license.
5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager.

B. Cost Estimate

1. If required as part of the scope of work, the Structural Engineer will prepare a cost estimate of structural work. This cost estimate shall describe work and clearly define inclusions, and exclusions.

PART 8 - Solicitation for Construction Contracting

8.1 The Structural Engineer shall respond to bidding questions as needed and as directed by the manager of the design team. The Structural Engineer will also assist in evaluating, grading, and ranking proposals with regard to the structural components of the bid, as directed by the ACCD project manager.

PART 9 - Construction Administration

9.1 The Structural Engineer shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work, and respond to requests as appropriate to the scope of work and in coordination with the manager of the design team. Responsibilities will include:

A. Processing submittals as directed by the manager of the design team.

B. Respond to Requests for Information (RFI) and write Proposal Requests (PR), and Architectural Supplemental Instructions (ASI) as directed by the manager of the design team.

C. Evaluate contractor's change proposals as directed by the manager of the design team and make recommendations.

D. Attend project meetings and visit the project site as determined by ACCD's project manager and the manager of the design team

PART 10 - Substantial Completion

10.1 The Structural Engineer shall develop a punch list for the structural components of the project at the time of substantial completion as agreed to by ACCD's project manager and the contractor. Punch list to be submitted to the manager of the design team, who will in turn submit to ACCD's project manager and the contractor.

PART 11 - Warranty Period

11.1 The Structural Engineer will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contractor may request additional services for review and professional opinions from the Structural Engineer.

PART 12 - Project Notebook

12.1 A Project Notebook shall be kept for each project and be available for review by ACCD, the manager of the design team, and/or the ACCD project manager. Project Notebooks will include all information pertinent to the design of the project.

A. It shall include but may not be limited to the following dividers and information:
   1. Design criteria
   2. Meeting notes
   3. Correspondence (letters, transmittals, etc.)
   4. Code reviews
   5. Structural system analysis
   6. Load calculations
   7. Specification information
   8. Cost estimates
   9. Miscellaneous

END OF SECTION 00 00 03

SECTION 00 00 04 – MECHANICAL AND PLUMBING ENGINEERING REQUIREMENTS

PART 1 - General

1.1 The Mechanical Engineer / design professional shall participate in all work sessions, reviews, and presentations; and work in conjunction with all other design professionals to provide integrated documentation. ACCD will participate in the project during Programing Definition through Substantial Completion and will approve work performed by design professionals at scheduled periods.

PART 2 - Design Scope

2.1 The mechanical and plumbing design shall consist of, but not be limited to the following:

A. Review, recognition, and utilization of desirable existing mechanical systems.

B. Design of mechanical and plumbing systems for building and site. Criteria for a particular mechanical system will vary somewhat from building to building and campus to campus, which may change certain parameters of the initial design considerations.
   1. Calculations used to determine loads shall be made available.
   2. Systems shall comply with applicable ANSI Standards.
   3. It shall not be assume that ACCD will provide or connect any piece of equipment, apparatuses, etc. or otherwise perform any services without specific prior agreement.

C. Mechanical and plumbing systems shall be designed based on general criteria and standards written in Section 22 and 23 of these Design and Construction Standards.

D. Interface mechanical system to existing energy system.

E. Coordinate mechanical and plumbing systems with public utilities and ACCD.

PART 3 - Submittal Requirements

3.1 The following are general requirements for submittals:

A. The Educational Standards and Design and Construction Standards are to be used as a basis for the design. The Mechanical Engineer is responsible for writing the specifications for the specific project. The Design and Construction Standards are not specifications, and may not be reproduced as such.

B. The Mechanical Engineer shall work in conjunction with the other design professionals in developing the design and documentation to assure that all documents are coordinated.

C. The Mechanical Engineer shall submit drawings, specifications, and calculations for review to ACCD at designated intervals. Intermediate reviews may be required if the scope of the project has been changed, if an earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was unaccepted by ACCD in whole or in part.

D. Any submittal comments received from ACCD, that the Mechanical Engineer cannot incorporate based on professional practice or due to project constraints, shall be responded to in writing to ACCD's project manager as early as practical but prior to the next submittal.

E. All mechanical and plumbing drawings and specifications shall bear the responsible Mechanical Engineer's name and registration number, address, telephone and fax numbers. It is not necessary to seal documents at all stages of the design. Refer to the Texas Engineering Practice Act. All items submitted shall be in compliance with the Texas Engineering Practice Act, rule 138.138(8) regarding signatures and engineering seals.

F. The Mechanical Engineer shall use ACCD's standard title block and set up drawings as agreed with the manager of the design team.

G. The ACCD project number shall be included in the title block, specifications and other contract documents.

H. Flow diagrams shall be drawn for each piping system including but not limited to steam, heating water, chilled water, hot and cold water, distilled water, fire standpipe, oxygen, compressed air, condensing water, gas, vacuum, and refrigerant systems. Mains and major branches shall show quantities of flow with size. All valve sizes shall be indicated.

I. Architectural room names and numbers shall be used on all plans and diagrams to indicate locations.

J. Where piping systems are to be installed underfloor, these shall be shown on an underfloor plan and not on the plan prepared for the space above. Floor plans for mechanical systems shall be drawn to show pipes, ducts, etc. on the floor in which they are installed.

K. Fume hoods, kitchen hoods, cage washers as applicable, and all other specialized mechanical or electrical equipment shall be included in the mechanical or electrical sections.

L. All construction details, equipment schedules and legends shall be shown on the drawings and shall not be incorporated in the specifications.

M. All equipment and material specifications shall be bound in the specifications and shall not be shown on the drawings.

N. Performance data schedules for all equipment shall be shown in schedules on the drawings.

O. A Project Notebook shall be kept for each project by the Mechanical Engineer. Details of the notebook requirements are listed at the end of this section.

P. Schedule
1. Prepare a schedule for the performance of services through the following milestones and submit at each project phase submittal:
   a. Programing Definition
   b. Schematic Design
   c. Design Development
   d. Construction Documents
   e. Contractor procurement
   f. Construction
   g. Occupancy/use
   h. Closeout

PART 4 - Programing Definition

4.1 The Programing Definition Phase includes several components. The Mechanical Engineer will work in coordination with the other design professionals and be involved in the Programing Definition phase as indicated below.

A. Workshop
1. The Mechanical Engineer should be included in any discussions regarding building systems.

B. Site / Building Analysis
1. The Mechanical Engineer shall research all relevant site and building issues, in coordination with the other design professionals, as outlined in the Programing Definition section of these standards.

C. Program
1. The Mechanical Engineer will give input to the Program as needed. The manager of the design team will submit the program for review and approval by ACCD.

D. Building Systems Developed
1. The Mechanical Engineer will develop concepts of the building systems in conjunction with the Architect. Differences in performance of the options shall be identified.
2. The design team will review concepts with ACCD for approval.

E. Conceptual Design
1. The Mechanical Engineer will be responsible for developing plans showing single line diagrams of major mechanical and plumbing systems.
2. A brief written narrative shall be written describing the scope of work for the mechanical and plumbing systems.

F. Cost Estimate

1. If required as part of scope of work, the Mechanical Engineer will prepare a cost estimate of mechanical and plumbing work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 5 - Schematic Design

5.1 Based on approval of the Programing Definition components, the Schematic Design submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications

1. Site Plan(s) at a scale consistent with architectural site plan showing location of existing utilities and site requirements (including scale, graphic scale, and north arrow).
2. Floor plans indicating mechanical rooms, equipment layout and single line duct and pipe routes.
3. Plumbing fixtures and equipment (this may be shown on architectural floor plan).
4. Preliminary equipment schedules indicating proposed flow rates, capacities, selections, and the building schedule filled out completely.
5. Outline specifications for each category of proposed work.

B. Other

1. Narrative describing proposed system, controls, gross design loads, supply and return air system, principal piping materials, and fire protection.
2. Initial selection of all major mechanical and plumbing equipment. Provide cut sheets of equipment.
3. Life Cycle Costs developed, if requested by the owner.
4. Initial code analysis including plumbing fixtures quantity requirements by code.

C. Cost Estimate

1. If required as part of scope of work, the Mechanical Engineer will prepare cost estimate of mechanical and plumbing work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 6 - Design Development

6.1 The Design Development submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications

1. Refinement of site plan(s) at scale consistent with the Architectural site plan showing existing and proposed utilities, (underground and overhead with sizes, valves, boxes, cleanouts, access ways, and manholes indicated), fire protection Siamese and hydrant locations.
2. Refinement of HVAC plans indicating:
   a. HVAC equipment (air handlers, pumps, compressors, etc. shown to scale with clearances indicated including coil pull space for A/C units).
   b. Medium pressure ductwork shown in double line format, placement of single/dual terminal units, and thermostats. Show major taps, splits, and duct sizes.
   c. Low pressure ductwork shown in single line format, not sized. Diffusers, grilles, and returns shown but not sized.
   d. Above ceiling space detail, cross-section and/or other appropriate drawing method to convey requirements for specific services such as special laboratory services, conduit, piping, ductwork, fire protection piping etc.
   e. Equipment schedules
3. Refinement of plumbing plans indicating:
   a. Plumbing fixtures, floor and roof drains, and special devices.
   b. Soil, waste and vent piping and main supply taps and piping sized.
   c. Typical riser diagrams.
   d. Special plumbing system requirements such as vacuum, compressed air de-ionized water, medical or laboratory gases.
   e. Equipment and plumbing schedules.
4. Fire protection plans indicating:
   a. Location of incoming supply, valves, fire pump, etc.
   b. Piping routes, sprinkler head locations in architecturally sensitive areas only, and fire department connections.
   c. Sizes of risers and trunks.
5. Specifications written to match the scope of work.

B. Other
1. Narrative and special environmental requirements such as equipment, space pressurization, processes, animals, odors, sterility, etc.
2. Code analysis finalized including plumbing fixtures quantity requirements by code.
3. Design loads for HVAC and plumbing.

C. Cost Estimate
1. If required as part of scope of work, the Mechanical Engineer will prepare a cost estimate of mechanical and plumbing work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 7 - Construction Documents

7.1 The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following:

A. Drawings / Specifications
   1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.
   2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated.
   3. Alternates, if any, shall be clearly written in documentation.
   4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Mechanical Engineer, including date of expiration of current license.
   5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager.

B. Cost Estimate
   1. If required as part of scope of work, the Mechanical Engineer will prepare a cost estimate of mechanical and plumbing work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 8 - Solicitation for Construction Contracting

A. The Mechanical Engineer shall respond to bidding questions as needed and as directed by the manager of the design team. The Mechanical Engineer will also assist in evaluating, grading, and ranking proposals with regard to the architectural components of the bid, as directed by ACCD's project manager.

PART 9 - Construction Administration

9.1 The Mechanical Engineer shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work, and respond to requests as appropriate to the scope of work and in coordination with the manager of the design team. Responsibilities will include:
   1. Process submittals as directed by the manager of the design team.
   2. Respond to Requests for Information (RFI's) and write Proposal Requests (PR), and Architectural Supplemental Instructions (ASI) as directed by the manager of the design team.

3. Evaluate contractor's change proposals as directed by the manager of the design team and make recommendations.
4. Attend project meetings and visit the project site as determined by ACCD's project manager and the manager of the design team.

PART 10 - Substantial Completion

10.1 The Mechanical Engineer shall develop a punch list for the mechanical and plumbing components of the project at the time of substantial completion and as agreed to by ACCD's project manager and the contractor. Punch list to be submitted to the manager of the design team, who will in turn submit to ACCD's project manager and the contractor.

PART 11 - Warranty Period

11.1 The Mechanical Engineer will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contractor may request additional services for review and professional opinions from the Mechanical Engineer.

PART 12 - Project Notebook

12.1 A Project Notebook shall be kept on each project and be available for review by ACCD, the manager of the design team, and/or the ACCD project manager. Project Notebooks will include all information pertinent to the design of the project. It shall include but may not be limited to the following dividers and information:

A. Design criteria

B. Meeting notes

C. Correspondence (letters, transmittals, etc.)

D. Code reviews

E. Energy compliance report

F. Utility information

G. Design calculations (as applicable) for:
   1. A/C loads
   2. Duct system pressure drop

3. Hydronic system pressure drop

H. Product selection cut sheets

I. Specification information

J. Cost estimates

K. Miscellaneous

END OF SECTION 00 00 04

SECTION 00 00 05 – ELECTRICAL ENGINEERING REQUIREMENTS

PART 1 - General

1.1 The Electrical Engineer / design professional shall participate in all work sessions, reviews, presentations and work in conjunction with all other design professionals to provide integrated documentation. ACCD will participate in the project during Programing Definition through Substantial Completion and will approve work performed by the design professionals at scheduled periods.

PART 2 - Design Scope

2.1 The electrical design shall consist of, but not be limited to the following:

A. Review, recognition, and utilization of desirable existing electrical systems.

B. Design concepts of the electrical systems and lighting for building and site.
   1. Calculations developed.
   2. Systems shall comply with applicable ANSI Standards.
   3. It shall not be assume that ACCD will provide or connect any piece of equipment, apparatuses, etc.; or otherwise perform any services without specific prior agreement.

C. Energy analysis to be developed.
   1. All calculations to be kept in notebook as described at the end of this section.

D. Electrical system to be designed based on general criteria and standards written in Section 26 and 27 of this Design and Construction Standards.

E. Interface mechanical system to existing energy system.

F. Coordinate mechanical and plumbing systems with public utilities and ACCD.

PART 3 - Submittal Requirements

3.1 The following are general requirements for submittals:

A. The Educational Standards and Design and Construction Standards are to be used as a basis for the design. The Electrical Engineer is responsible for writing the specifications for the specific project. The Design and Construction Standards are not specifications, and may not be reproduced as such.

B. The Electrical Engineer shall work in conjunction with the other design professionals in the developing the design and documentation to assure that all documents are coordinated.

C. The Electrical Engineer shall submit drawings, specifications, and calculations for review by ACCD at designated intervals. Intermediate reviews may be required if the scope of the project has been changed, if an earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was unaccepted by ACCD in whole or in part.

D. Any submittal comments received from ACCD, that the Electrical Engineer cannot incorporate based on professional practice or due to project constraints, shall be responded to in writing to ACCD's project manager as early as practical but prior to the next submittal.

E. All Electrical drawings and specifications shall bear the responsible Electrical Engineer's name and registration number, address, telephone and fax numbers. It is not necessary to seal documents at all stages of the design. Refer to the Texas Engineering Practice Act. All items submitted shall be in compliance with the Texas Engineering Practice Act, rule 138.138(8) regarding signatures and engineering seals.

F. The Electrical Engineer shall use ACCD's standard title block and set up drawings as agreed with the manager of the design team.

G. The ACCD project number shall be included in the title block, specifications and other contract documents.

H. Lighting, Power, and Special Systems Plans. These plans should follow each other by area. For example:
   1. First floor lighting, followed by first floor power, followed by first floor special systems, followed by second floor lighting, followed by second floor power, followed by second floor special systems. Or;
   2. East half of building lighting, followed by east half of building power, followed by east half of building special systems, followed by west half of building lighting, followed by west half of building power, followed by west half of building special systems.
   3. Electrical one-line and riser diagrams
   4. Panel board schedules
   5. Schedules and details
   6. Riser diagrams of all special systems

I. Delineation:
   1. To permit cost effective printing, distribution, handling, and storage of the Contract Documents, all work shall be accomplished in a manner that will allow the drawings to be reduced to a legible one half size.
   2. Circuitry between lighting fixtures, electrical outlets, etc. shall be indicated using straight lines. "Homeruns", short connections between devices, etc. may be shown with the use of curved lines. Circuit designations for other than standard #12 branch circuits and #10 "homeruns" in 3/4" conduit shall include conduit size and quantity and size of conductors.

J. Symbols Schedule

1. The Design Engineer shall use standard symbols and abbreviations and insure that there is uniformity between new and existing projects. It shall also indicate the different line types used to define circuits installed underground, overhead, etc. and all abbreviations. The symbols and abbreviations sheet shall be issued as a separate drawing with each project and shall be a part of the Contract Documents.
2. Special systems symbols will be included in a project where the associated symbols are not part of the standard symbols schedule. The new symbols shall be added to the standard symbols schedule or a supplementary symbols schedule shall be created. Where possible, supplementary schedules shall be located on the same sheet as their associated system. Where supplementary schedules are used they shall be referenced on the standard symbols schedule.
3. A formal schedule for use by the Design Engineer shall be issued by the Coordinating Engineer with the final design guidelines.

K. Sheet Congestion

1. To prevent congested drawings, all electrical, lighting, and power shall be shown on separate floor plans.
2. Special systems such as security, fire alarm, etc. shall not be shown on a lighting or power floor plan, but shall be grouped together on a separate floor plan.
3. Projects that are drawn at larger scales, i.e., 1/4" = 1'-0" or projects which have minimal information shown may be combined on a common floor plan. Such deviations shall be approved by the manager of the design team.

L. Equipment Layout

1. The Design Engineer shall show the physical size and location of all electrical equipment to scale to insure that adequate space is provided and the location is coordinated with all other equipment, etc.

M. Circuit Identification

1. When circuiting electrical items, the Design Engineer shall show each individual circuit as a separate homerun in lieu of grouping multiple circuits into common raceways. When circuiting the plans, the Engineer shall arrange the circuits physically in a logical manner so as to permit the Contractor to easily group circuits into multi-circuit homeruns. The Contractor will be allowed to group a maximum of three circuits per conduit without the Engineer's permission, but must obtain permission from the manager of the design team in order to group more.
2. In rooms with multiple switching, the switching shall be indicated using letter subscripts (a, b, c...) adjacent to each switch and the associated light fixtures. In rooms with one switch, a switch leg shall be shown from the switch to a light fixture. Crosshatching to show the number of conductors is not necessary.
3. Conductor quantities and conduit sizes must be indicated for each circuit homerun where it exceeds two #10 conductors and a #10 ground in a 3/4" conduit.
4. Conductor sizes must be indicated for each circuit homerun other than #10 conductors.

5. Care must be taken when circuiting to facilitate the balancing of phases of a panel. Loads should be fairly equal or if that is not possible, the phase assignment of the loads should be such that subsequent groups of loads will offset the imbalance. Refer to Section 26 00 05, Panel board Schedules.

N. A Project Notebook shall be kept for each project by the Electrical Engineer. Details of notebook requirements are listed below.

O. Schedule
1. Prepare a schedule for the performance of services through the following milestones and submit at each project phase submittal:
   a. Programing Definition
   b. Schematic Design
   c. Design Development
   d. Construction Documents
   e. Contractor procurement
   f. Construction
   g. Occupancy/use
   h. Closeout

PART 4 - Programing Definition

4.1 The Programing Definition Phase includes several components. The Electrical Engineer will work in coordination with the other design professionals and be involved in the Programing Definition phase as indicated below.

A. Workshop
1. The Electrical Engineer should be included in any discussions regarding building systems.

B. Site / Building Analysis
1. The Electrical Engineer shall research all relevant site and building issues, in coordination with the other design professionals, as outlined in the Programing Definition section of these standards.

C. Program
1. The Electrical Engineer will give input to the Program as needed. The manager of the design team will submit the program for review and approval by ACCD.

D. Building Systems Developed
1. The Electrical Engineer will develop concepts of the building systems in conjunction with the Architect. Differences in performance of the options shall be identified.
2. The design team will review concepts with ACCD for approval.

E. Conceptual Design
1. The Electrical Engineer will be responsible for conceptual design of the electrical system and lighting design. Lighting concepts to be worked in conjunction with Architect. Drawings shall be developed showing preliminary lighting and power layouts.
2. A brief narrative shall be written describing the scope of work for the electrical systems including switchgear voltages, gross design loads, fire detection systems, and lighting. The narrative shall include proposed major systems and alternate system considered.

F. Cost Estimate
1. If required as part of scope of work, the Electrical Engineer will prepare a cost estimate of electrical work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 5 - Schematic Design

5.1 Based on approval of the Programing Definition components, the Schematic Design submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications
1. Site Plan(s) at scale consistent with Architectural Site Plan showing electrical service location and characteristics, sub- stations, vaults etc. (including scale, graphic scale, and north arrow)
2. Demolition plans if required indicating existing system and lighting, and include fixtures to be removed.
3. Floor plans indicating electrical rooms, equipment layout, lighting layout, panel locations, electrical rooms, telephone, and data rooms.
    a. Equipment space allocations, including transformer rooms, switchboard rooms, panel boards, and other electrical distribution equipment. Space allocations must also include the space required for special systems, such as telephone, fire alarms, clocks, bells, emergency systems, television systems, etc. The Design Engineer must also take into consideration equipment access space, maintenance space, and code required working space clearances when making space allocations. All electrical equipment and space allocations should be shown on the Schematic Design Drawings.
4. Typical lighting in all areas indicated on plans.
5. Rough, one-line or riser diagram.
6. Typical capacities and sizes shown where available.
7. Preliminary equipment and lighting schedules.
8. Outline specifications for each category of proposed work

B. Other
1. Initial selection of all major electrical equipment and lighting.
2. Schematic design of load analysis
3. Life Cycle Costs shall be developed if requested by the owner.
4. Statement of probable cost for electrical systems.

5. Code analysis. All existing code deficiencies shall be indicated. A method of correction shall be recommended and an estimate of the cost of that recommendation shall be included.

C. Cost Estimate

1. If required as part of scope of work, the Electrical Engineer will prepare a cost estimate of electrical work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 6 - Design Development

6.1 The Design Development submittal shall incorporate review comments from both ACCD and the ACCD project manager. The submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications

1. Refinement of site plan and floor plans(s) at a scale consistent with architectural site plan showing electrical service location and characteristics, sub-stations, vaults etc. (including scale, graphic scale, and north arrow).
2. Refinement of demolition plans, if required, indicating existing system and lighting. All lighting and electrical systems being kept or removed shall be indicated.
3. Refinement of floor plans indicating electrical rooms, equipment layout, lighting layout, panel locations, electrical rooms, telephone, and data rooms.
4. Refinement of lighting, panel, and equipment schedules.
5. Schedule of all rooms with maintained foot candle levels.
6. Specifications written to match the scope of work.

B. Cost Estimate

1. If required as part of scope of work, the Electrical Engineer will prepare a cost estimate of electrical work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 7 - Construction Documents

7.1 The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following:

A. Drawings / Specifications

1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal shall be 100% complete documents for the design professionals, lacking only final comments

from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.

2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated.
3. Alternates, if any, shall be clearly written in documentation.
4. Upon completion of the final submittal, the documents (drawings and specifications) shall include a dated and signed seal of the State of Texas licensed Electrical Engineer, including date of expiration of current license.
5. Drawings shall be submitted by the manager of the design team to the appropriate jurisdiction for building permit as agreed to with ACCD's project manager.

B. Other

1. Energy analysis shall be documented.

C. Cost Estimate

1. If required as part of scope of work, the Electrical Engineer will prepare a cost estimate of electrical work. This cost estimate shall describe the work and clearly define inclusions and exclusions

PART 8 - Solicitation for Construction Contracting

8.1 The Electrical Engineer shall respond to bidding questions as needed and as directed by the manager of the design team. The Electrical Engineer will also assist in evaluating, grading, and ranking proposals with regard to the electrical components of the bid, as directed by ACCD's project manager.

PART 9 - Construction Administration

9.1 The Electrical Engineer shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work, and respond to requests as appropriate to the scope of work and in coordination with the manager of the design team. Responsibilities will include:

A. Process submittals as directed by the manager of the design team.

B. Respond to Requests for Information (RFI's and write Proposal Requests (PR), and Architectural Supplemental Instructions (ASI) as directed by the manager of the design team.

C. Evaluate contractor's change proposals as directed by the manager of the design team and make recommendations.

D. Attend project meetings and visit the project site as determined by ACCD's project manager and the manager of the design team.

PART 10 - Substantial Completion

10.1 The Electrical Engineer shall develop a punch list for the electrical components of the project at the time of substantial completion and as agreed to by ACCD's project manager and the contractor. Punch list to be submitted to the manager of the design team, who will in turn submit to ACCD's project manager and the contractor.

PART 11 - Warranty Period

11.1 The Electrical Engineer will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contractor may request additional services for review and professional opinions from the Electrical Engineer.

PART 12 - Project Notebook

12.1 A Project Notebook shall be kept for each project and be available or review by ACCD, the manager of the design team, and/or the ACCD project manager. Project Notebooks will include all information pertinent to the design of the project.

A. It shall include the following dividers and information:
   1. Design criteria
   2. Meeting notes
   3. Correspondence (letters, transmittals, etc.)
   4. Utility information (power, telephone, communications, etc.)
   5. Mechanical and plumbing equipment information and cut sheets
   6. Lighting (calculations, cut sheets, schedules, etc.)
   7. Power (load calculations, panel board schedules, feeder calculations, risers, fault current calculations, and voltage drop calculations)
   8. Specification information
   9. Special systems (details, codes, and design information for special systems)
   10. Cost estimates
   11. Miscellaneous

END OF SECTION 00 00 05

SECTION 00 00 06 – CIVIL ENGINEERING REQUIREMENTS

PART 1 - General

1.1 The Civil Engineer / design professional shall participate in all work sessions, reviews, presentations, and work in conjunction with all other design professionals to provide integrated documentation. ACCD will participate in the project during Programing Definition through Substantial Completion and will approve work performed by design professionals at scheduled periods.

PART 2 - Design Scope

A. The civil engineering design shall consist of, but not be limited to the following:
   1. Demolition, protection, salvaging, recycling, and disposal of existing site components.
   2. Review, recognition, and utilization of desirable existing features such as water, tree groupings, geological formations (in coordination with the Landscape Architect).
   3. Layout and design of streets, bridges, parking lots, parking structures, sidewalks, and pavements (designed in coordination with the Landscape Architect).
   4. Site utilities.
   5. Outdoor lighting if applicable and within assigned scope of services (designed in coordination with Landscape Architect).
   6. Drainage and site grading if applicable and within assigned scope of services (designed in coordination with Landscape Architect).
   7. Special outdoor features such as ramps, walls, fences, shelters, and/or other engineered elements if applicable and within assigned scope of services (designed in coordination with Landscape Architect).

PART 3 - Submittal Requirements

3.1 The following are general requirements for submittals:

A. The Design and Construction Standards are to be used as a basis for the design. The Civil Engineer is responsible for writing the specifications for the specific project. These standards are not specifications, and may not be reproduced as such.

B. The Civil Engineer shall work in conjunction n with the other design professionals in developing the design and documentation to assure that all documents are coordinated.

C. The Civil Engineer shall submit plans, specifications, and calculations for review by ACCD at designated intervals. Intermediate reviews may be required if the scope of the project has been changed, if an

earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was unaccepted by ACCD in whole or in part.

D. Any submittal comments received from ACCD, that the Civil Engineer cannot incorporate based on professional practice or due to project constraints, shall be responded to in writing to ACCD's project manager as early as practical but prior to the next submittal.

E. All Civil Engineering drawings and specifications shall bear the responsible Civil Engineer's name and registration number, address, telephone and fax numbers. It is not necessary to seal documents at all stages of the design. Refer to the Texas Engineering Practice Act. All items submitted shall be in compliance with the Texas Engineering Practice Act, regarding signatures and engineering seals.

F. The Civil Engineer consultant shall use ACCD's standard title block and set up drawings as agreed with the manager of the design team.

G. The ACCD project number shall be included in the title block, specifications and other contract documents.

H. Schedule
   1. Prepare a schedule for the performance of services through the following milestones and submit at each project phase submittal:
      a. Programing Definition
      b. Schematic Design
      c. Design Development
      d. Construction Documents
      e. Contractor procurement
      f. Construction
      g. Occupancy/use
      h. Closeout

PART 4 - Programing Definition

4.1 The Programing Definition Phase includes several components. The Civil Engineer will work in coordination with the other design professionals and be involved in the Programing Definition phase as indicated below.

A. Workshop
   1. The Civil Engineer should be included in any discussions regarding site issues and building siting.

B. Site Analysis
   1. The Civil Engineer shall research all relevant site and issues, in coordination with the other design professionals, as outlined in the Programing Definition section of these standards.

C. Program
1. The Civil Engineer will give input to the Program as needed. The manager of the design team will submit the program for review and approval by ACCD.

D. Conceptual Design
1. The Civil Engineer will be responsible for site conceptual design, including a site plan to convey site design concepts illustrating all major civil engineering elements.
2. A brief narrative shall be written of the scope of work describing storm drainage, utilities, and hardscape design elements.

E. Cost Estimate
1. If required as part of scope of work, the Civil Engineer will prepare a cost estimate of civil work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 5 - Schematic Design

5.1 Based on approval of the Programing Definition Components, the Schematic Design submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications
1. Site plan(s) at scale consistent to convey design concept (including scale, graphic scale, and north arrow)
2. Site utilities illustrated and identified.
3. Major civil engineering elements illustrated to convey site design concept.
4. Vehicular and pedestrian circulation layout illustrated.
5. Relationship of all proposed work to existing site survey illustrated.
6. Outline specifications for each category of proposed work.

B. Cost Estimate
1. If required as part of scope of work, the Civil Engineer will prepare a cost estimate of civil work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 6 - Design Development

6.1 The Design Development submittal shall incorporate review comments from both ACCD and the ACCD project manager. The submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications
1. Refinement of site drawing(s) at a scale consistent with Architectural Site Plan, including scale, graphic scale, and north arrow.

2. Site plan illustrating complete scope of engineered features.
3. Site plan illustrating complete scope of outdoor lighting if within consultant's scope of work.
4. Hardscape materials within scope of civil work identified.
5. Temporary storm water runoff and containment to meet applicable standards illustrated.
6. Specifications written to match the scope of work.

B. Cost Estimate

1. If required as part of scope of work, the Electrical Engineer will prepare a cost estimate of civil work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 7 - Construction Documents

7.1 The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following:

A. Drawings and Specifications

1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal should be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.
   a. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated.
   b. Alternates, if any, shall be clearly written in documentation.
   c. Upon completion of the final submittal, the documents (drawings and specifications) should include a dated and signed seal of the State of Texas licensed Civil Engineer, including date of expiration of current license.

B. Cost Estimate

1. If required as part of scope of work, the Civil Engineer will prepare a cost estimate of civil work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 8 - Solicitation for Construction Contracting

8.1 The Civil Engineer shall respond to bidding questions as needed and as directed by the manager of the design team. The Civil Engineer will also assist in evaluating, grading, and ranking proposals with regard to the architectural components of the bid, as directed by ACCD's project manager.

PART 9 - Construction Administration

9.1 The Civil Engineer shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work, and respond to requests as appropriate to the scope of work and in coordination with the manager of the design team. Responsibilities will include:

A. Process submittals as directed by the manager of the design team.

B. Respond to Requests for Information (RFI's) and write Proposal Requests (PR), and Architectural Supplemental Instructions (ASI) as directed by the manager of the design team.

C. Evaluate contractor's change proposals as directed by the manager of the design team and make recommendations.

D. Attend project meetings and visit the project site as determined by ACCD's project manager and the manager of the design team.

PART 10 - Substantial Completion

10.1 The Civil Engineer shall develop a punch list for the civil components of the project at the time of substantial completion and as agreed to by ACCD's project manager and the contractor. Punch list to be submitted to the manager of the design team, who will in turn submit to ACCD's project manager and the contractor.

PART 11 - Warranty Period

A. The Civil Engineer will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contractor may request additional services for review and professional opinions from the Civil Engineer.

PART 12 - Project Notebook

12.1 A Project Notebook shall be kept for each project and be available for review by ACCD, the manager of the design team, and/or the ACCD project manager. Project Notebooks will include all information pertinent to the design of the project.

A. It shall include but may not be limited to the following dividers and information:
   1. Design criteria
   2. Meeting notes
   3. Correspondence (letters, transmittals, etc.)

4. Code reviews
5. Calculations for drainage, storm water, sanitary waste, etc.
6. Cut sheets for product selections
7. Specification information
8. Cost estimates
9. Miscellaneous

END OF SECTION 00 00 06

SECTION 00 00 07 – LANDSCAPE ARCHITECTURE REQUIREMENTS

PART 1 - General

1.1 The Landscape Architect / design professional shall participate in all work sessions, reviews, and presentations and work in conjunction with all other design professionals to provide integrated documentation. ACCD will participate in the project during Programing Definition through Substantial Completion and will approve work performed by the design professionals at scheduled periods.

PART 2 - Design Scope

2.1 The Landscape Architectural Design shall consist of, but not be limited to the following:

A. Grading and drainage (designed in coordination with Civil Engineer)

B. Review, recognition, and utilization of desirable existing features such as water, tree groupings, geological formations.

C. Special outdoor amenities such as courtyards, sculpture, plazas, and fountains.

D. Exterior lighting and landscape illumination.

E. Site improvements such as outdoor furnishings and signage.

F. Irrigation system design.

G. Plant material selection and locations.

H. Pedestrian and vehicular circulation including walks, roads, parking, ramps, bike compounds, service lanes, etc. (Designed in coordination with Civil Engineer).

I. Siting of building(s) (in coordination with Architect and Civil Engineer).

J. Requirements of the City of San Antonio's Tree Preservation and Landscape Ordinances incorporated into the landscape design (for those campuses that fall within the jurisdiction of the City of San Antonio).

PART 3 - Submittal Requirements

3.1 The following are general requirements for submittals:

A. The Design and Construction Standards are to be used as a basis for the design. The Landscape Architect is responsible for writing the specifications for the specific project. These standards are not specifications, and may not be reproduced as such.

B. The Landscape Architect shall work in conjunction with the other design professionals in developing design and documentation to assure that all documents are coordinated.

C. The Landscape Architect shall submit plans, specifications, and calculations for review by ACCD at the designated intervals. Intermediate reviews may be required if the scope of the project has been changed, if an earlier review is needed to finalize scope prior to proceeding, or if the previous submittal was unaccepted by ACCD in whole or in part.

D. Any submittal comments received from ACCD, that the Landscape Architect cannot incorporate based on professional practice or due to project constraints, shall be responded to in writing to ACCD's project manager as early as practical but prior to the next submittal.

E. The landscape irrigation drawings shall bear the seal of a current Texas-licensed landscape irrigator.

F. All Landscape Architectural drawings and specifications shall bear the responsible Landscape Architect's name and registration number, address, telephone and fax numbers. It is not necessary to seal documents at all stages of the design.

G. Refer to the rules of the TBAE. All items submitted shall be in compliance with the Texas Board of Architectural Examiners (TBAE) regarding signatures and seals

H. The Landscape Architect shall use ACCD's standard title block and set up drawings as agreed with the manager of the design team.

I. The ACCD project number shall be included in the title block, specifications and other contract documents.

J. Schedule

1. Prepare a schedule for the performance of services through the following milestones and submit at each project phase submittal:
   a. Programing Definition
   b. Schematic Design
   c. Design Development
   d. Construction Documents
   e. Contractor procurement
   f. Construction

g. Occupancy/use
h. Closeout

PART 4 - Programing Definition

4.1 The Programing Definition Phase includes several components. The Landscape Architect will work in coordination with the other design professionals and be involved in the Programing Definition phase as indicated below.

A. Workshop
1. The Landscape Architect should be included in any discussions regarding site issues and building siting.

B. Site Analysis
1. The Landscape Architect shall research all relevant site and building issues, in coordination with the other design professionals, as outlined in the Programing Definition section of these standards.

C. Program
1. The Landscape Architect will give input to the Program as needed. The manager of the design team will submit the program for review and approval by ACCD.

D. Conceptual Design
1. The Landscape Architect will be responsible for site design, including a site plan to convey site design concepts illustrating all major site elements. This should include parking areas, major circulation, special features, and landscape concepts.
2. A brief narrative shall be written of the scope and character of the landscape development, both hardscape and softscape, including proposed special features.

E. Cost Estimate
1. If required as part of scope of work, the Landscape Architect will prepare a cost estimate of landscape and irrigation work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 5 - Schematic Design

5.1 Based on approval of the Program and Conceptual Design, the Schematic Design submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications

1. Site Plan(s) at a scale sufficient to illustrate concepts (including scale, graphic scale, and north arrow)
2. Relationships of all proposed work to existing site features.
3. Site concept including trees, walls, fences, planting areas, and special site features to convey overall site design.
4. Indication of areas to receive landscape irrigation with water source located.
5. Vehicular and pedestrian circulation layout illustrated
6. Site improvements including furnishings and signage indicated.
7. Outline specifications for each category of proposed work.

B. Cost Estimate

1. If required as part of scope of work, the Landscape Architect will prepare a cost estimate of landscape and irrigation work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 6 - Design Development

6.1 The Design Development submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design professionals and include the following:

A. Drawings / Specifications

1. Refinement of site plan(s) at scale selected to convey the design (including scale, graphic scale, and north arrow).
2. Site plan illustrating complete scope of all landscape architectural elements including hardscape elements, site lighting, and hardscape materials.
3. Grading plan indicating existing and proposed grades.
4. Plant materials identified and illustrated on a site plan.
5. Generally develop the irrigation plan to illustrate provision of coverage, and types of components (sprays on risers, pop- up sprays, rotary, drip systems, etc.)
6. Specifications written to match the scope of work.

B. Cost Estimate

1. If required as part of scope of work, the Landscape Architect will prepare a cost estimate of landscape and irrigation work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 7 - Construction Documents

7.1 The Construction Document submittal shall incorporate review comments from both ACCD and ACCD's project manager. The submittal shall be developed in coordination with the other design

professionals, and submitted by the manager of the design team at three stages: a 65% submittal, a 98% submittal, and a 100% submittal. The submittal shall include the following:

A. Drawings /Specifications
   1. Drawings and Specifications shall be completed to the appropriate level. The 98% submittal should be 100% complete documents for the design professionals, lacking only final comments from ACCD. The 100% submittal will incorporate comments from the previous submittal into the documentation.
   2. Drawing symbols, equipment schedules, and abbreviations shall be clearly indicated.
   3. Alternates, if any, shall be clearly written in documentation.
   4. Upon completion of the final submittal, the documents (drawings and specifications) should include a dated and signed seal of the State of Texas-licensed Landscape Architect. Landscape irrigation drawings and specifications shall include the dated and signed seal of the State of Texas- licensed Landscape Irrigator.
   5. The Landscape Architect shall prepare the Tree Preservation Plan and Tree Affidavit form, required as part of the building permit process.

B. Cost Estimate
   1. If required as part of scope of work, the Landscape Architect will prepare a cost estimate of landscape and irrigation work. This cost estimate shall describe the work and clearly define inclusions and exclusions.

PART 8 - Solicitation for Construction Contracting

8.1 The Landscape Architect shall respond to bidding questions as needed and as directed by the manager of the design team. The Landscape Architect will also assist in evaluating, grading, and ranking proposals with regard to the architectural components of the bid, as directed by ACCD's project manager.

PART 9 - Construction Administration

9.1 The Landscape Architect shall participate in meetings, visit the site at appropriate intervals to observe the progress of the work, and respond to requests as appropriate to the scope of work and in coordination with the manager of the design team. Responsibilities will include:
   1. Process submittals as directed by the manager of the design team.
   2. Respond to Requests for Information (RFI's) and write Proposal Requests (PR), and Architectural Supplemental Instructions (ASI) as directed by the manager of the design team.
   3. Evaluate contractor's change proposals as directed by the manager of the design team and make recommendations.

4. Attend project meetings and visit the project site as determined by ACCD's project manager and the manager of the design team.

PART 10 - Substantial Completion

10.1 The Landscape Architect shall develop a punch list for the landscape components of the project at the time of substantial completion and as agreed to by ACCD's project manager and the contractor. Punch list to be submitted to the manager of the design team, who will in turn submit to ACCD's project manager and the contractor.

PART 11 - Warranty Period

11.1 The Landscape Architect will typically not have any responsibilities during this time. If however, there are issues that arise regarding product failure, ACCD and/or the contractor may request additional services for review and professional opinions from the Landscape Architect.

PART 12 - Project Notebook

12.1 A Project Notebook shall be kept for each project and be available for review by ACCD, the manager of the design team, and/or the ACCD project manager. Project Notebooks will include all information pertinent to the design of the project.

A. It shall include but may not be limited to the following dividers and information:
   1. Design criteria
   2. Meeting notes
   3. Correspondence (letters, transmittals, etc.)
   4. Code review
   5. Site evaluation of existing trees and other plant materials
   6. Cut sheets of products and plant materials
   7. Specification information
   8. Cost estimates
   9. Tree Preservation Plan and Tree Affidavit form
   10. Miscellaneous

END OF SECTION 00 00 07

Division 00 – Introduction and Professional Requirements

SECTION 00 00 08-01 – ACCD REVIT STANDARDS

PART 1 - General

1.1 ACCD Revit standards define expectations for using Revit. This document was developed collaboratively by nationally established conventions from public, federal, and educational institutions.

1.2 Adherence to these standards ensures a uniform quality of work across teams and offices, while improving the ability to exchange project information (BIM) and respond to evolving design technologies.

1.3 This standard references multiple resources.

A. ACCD Minimum Modeling Matrix

B. BIM Forum Level of Development Specification Guide

C. AutoCAD Deliverable

1. In addition to files delivered to ACCD in Revit, files shall also be provided in AutoCAD per the standards defined in SECTION 00 00 08-03 – AUTOCAD REQUIREMENTS.

PART 2 - Project Setup

2.1 BIM Project Execution Plan (PXP)

A. Projects that require a BIM must develop a BIM PxP. The BIM PxP defines communication, project execution, uses of the model, and data exchange protocols for the lifecycle of the project.

B. The Digital Practice Managers are responsible for preparing BIM PxPs based on the standard ACCD BIM PxP Template, unless contractually precluded. The BIM PxP will be reviewed, revised, and approved at the project BIM kickoff meeting. The ACCD BIM Guide contains additional information on the BIM kickoff process.

2.2 BIM project coordinator

A. The project manager and Digital Practice Manager will choose a BIM project coordinator for projects as required. The BIM project coordinator supports the project team in the modeling process and

executes the BIM PxP. The complete scope of responsibilities of the BIM project coordinator is defined in the BIM PxP.

2.3 Project Template

A. The BIM project coordinator may choose to setup the project using multiple linked discipline models or a single model containing all disciplines. The table below lists the standard Imperial templates. Metric versions are also available.

Table 1: Example

Name	Description
ACCD Combined Project.rte	All disciplines inclusive template (Architectural, Interior, Structural, MEP, FP)
ACCD Starter Project Arch.rvt	Architectural starter project file. Workset enabled and pre-linked to disciplines.
ACCD Starter Project Strut.rvt	Structural starter project file. Workset enabled and pre-linked to disciplines.
ACCD Starter Project MEP.rvt	MEP starter project file. Workset enabled and pre-linked to disciplines.
ACCD Starter Project FPLS.rvt	Fire Protection and Life Safety starter project. Workset enabled and pre-linked to disciplines.

2.4 Project File Naming Convention

Table 2

File Types	Naming Format	Example
Central File	[Acronym]–[000]–[Modifier].rvt	ACR-001-MEP.rvt
Local File	[Acronym]–[000]–[Modifier]_[UserLoginName].rvt	ACR-002-FPLS_crthomas.rvt
Standalone	[Acronym]–[000]–[Modifier]_STANDALONE.rvt	ACR-001-ARCH_STANDALONE.rvt

Table 3

Identifier	Description	
Acronym	Project acronym, typically 3 letters. All caps.	Required
000	Last 3 digits of the project number.	Optional
Modifier	Model description such as discipline, office, building identifier for designing multiple buildings, i.e. Arch, Struct, MEP, Site, MSP, ATL, StructOMA, Parking.	Required
STANDALONE	All caps and will be present in NON-workset enabled files.	Required
UserLoginName	Automatically generated by Revit, when user creates new local.	Automated

2.5 Worksharing: Model Structure and Worksets

A. Worksharing facilitates multiple users simultaneously working on a single project. The BIM project coordinator works with the project team to divide the project into worksets that optimize workflow, productivity, and data management. The BIM project coordinator may re-configure model structure and worksets to maintain optimal performance throughout the project lifecycle.

B. The diagram below illustrates the relationship between linked discipline models.

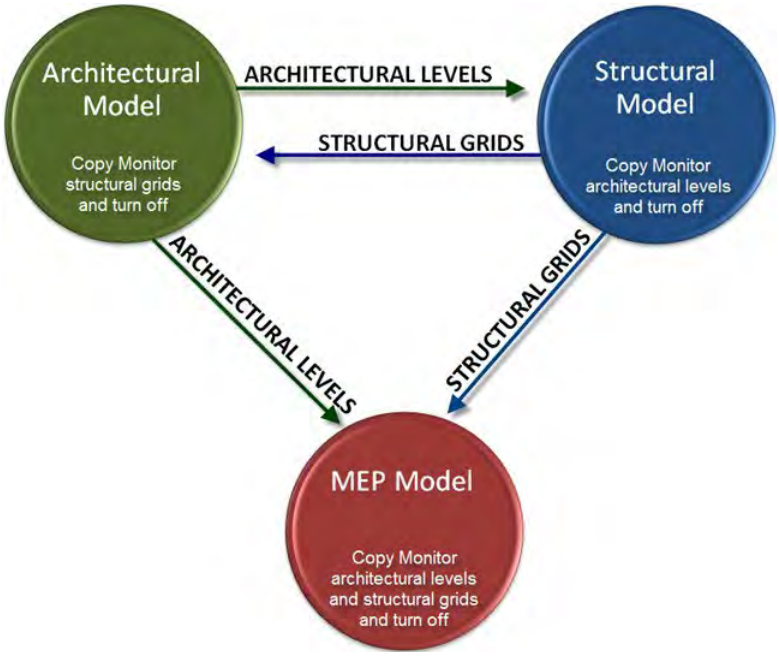


Figure 1: Relationship between linked discipline models

C. Very large projects may require models to be further subdivided to improve performance. Recommended model divisions:

Table 4

D.

Preferred Options	If Necessary
Discipline Groups	Individual Towers
Disciplines	Building Area
Building Core	Level
Building Shell	Expansion Joints
Interior Design	Building Shapes
Building System	Wings

Each linked Revit and DWG file will have a distinct work set. Do not create work sets by object type (Revit model category). Work sets are not intended for visibility control.

Table 5

Workset Naming			
Architectural Model	**Structural Model**	**Mechanical Model**	**Combined Model**
zz_RVT_Struct	zz_RVT_Arch	zz_RVT_Arch	zz_CAD_Civil

zz_RVT_Mech	zz_RVT_Mech	zz_RVT_Struct	zz_RVT_Fire Protection
zz_CAD_Civil	zz_CAD_Civil	zz_CAD_Civil	Shared Levels and Grids
Architectural Levels	Structural Levels	Mechanical Levels	Structural
Architectural Grids	Structural Grids	Mechanical Grids	Architectural
Exterior Shell	Foundation	Heating Systems	FF&E
Interior Architecture	Roof Structural Framing	Cooling Systems	Mechanical HVAC
FF&E		Ventilation	Mechanical Plumbing

PART 3 - Views

3.1 View Templates

A. View templates ensure consistency, automate organization, and simplify changes. View templates should be assigned to most working views. Views found in a "??" project browser folder without an assigned view template, are subject to deletion.

3.2 Scope Boxes

A. Scope boxes ensure consistent cropping across repetitive views, and are the primary method to define cropping of building areas.
   1. Name scope boxes according to use or match key plan areas (Overall, Area A, Area B).
   2. Scope box creation/modification shall be approved or facilitated through the team's BIM project coordinator.

3.3 View Naming Convention

A. Consistent view naming is required. The standard for view naming provides flexibility for project needs. Deviations should be coordinated with the BIM project coordinator.
   1. Use all CAPITAL letters in view names.
   2. View names should describe the view's orientation, use, or location.
   3. Schedules and legends shall be named with a prefix indicating discipline or general use.

B. Example view naming:
   1. **Plan Views: [Use/Orientation, Level, Area/Space]**
      a. DEMO PLAN LEVEL 1 AREA A
      b. ENLARGED PLAN LEVEL 1 TOILET ROOM 101
      c. REFLECTED CEILING PLAN LEVEL 2
      d. MECHANICAL ROOF PLAN PARTIAL
   2. **Elevation Views: [Use/Location, Direction]**
      a. EXTERIOR - NORTH ELEVATION
      b. ROOM 101 - SOUTH ELEVATION

3. **Section Views: [Use, Location, Direction if applicable]**
   a. WALL SECTION AT TYPICAL WINDOW
   b. MECHANICAL SECTION AT CORRIDOR PLENUM
   c. EXTERIOR DETAIL SECTION AT TOP OF WALL
4. **3D Views: [View Style, Location/Description]**
   a. AXONOMETRIC VIEW AT RECEPTION DESK
   b. DIAGRAM - SANITARY RISER
5. **Schedules/Legends: [Discipline Designator, Use/description]**
   a. 01 - GENERAL - CODE - AREA SCHEDULE
   b. 08 - ARCH - DOOR SCHEDULE
   c. 09 - INTERIORS - ROOM FINISH SCHEDULE
   d. 12 - PLUMBING FIXTURE CONNECTION SCHEDULE1
   e. 15 - LIGHTING FIXTURE SCHEDULE
6. **Drafting Views: [Use/description]**
   a. DIFFUSER TO DUCT CONNECTION
   b. ONE LINE DIAGRAM
   c. PIPING SCHEMATIC
7. **Addenda/RFI/ASI: [TYPE#xa – View Name]**

Table 6

Identifier	Description
Type	ADD - Addendum RFI - Request for Information ASI - Architect's Supplemental Instruction
#	#
x	Addendum, RFI, or ASI number
a	Attachment number for Addendum, RFI, or ASI

   a. ADD#1a - LEVEL 1
   b. ADD#1b - LEVEL 1
   c. ADD#1a - LEVEL 2
   d. ASI#23e – COLUMN DETAIL
   e. RFI#2a – SECTION AT ENTRY
8. **RFP/Change Orders: [TYPE#xa – View Name]**

Table 7

Identifier	Description
Type	RFP - Request for Proposal CO - Change of Order
#	#
x	RFP or Change Order number
a	Attachment number for RFP or Change Order

   a. RFP#12a – LEVEL 1
   b. CO#1a – LEVEL 1
   c. CO#1b – LEVEL 2

PART 4 - Linking, Importing and Exporting

4.1 CAD Links

A. CAD files can be linked or imported into Revit. Best practice is to link CAD files to accommodate ongoing changes in the DWG. If the CAD file will never change, it may be imported. Consult the project coordinator or Digital Practice Manager before importing CAD files.

B. Before linking a CAD file, open it in its native software, check for errors and extraneous objects, and purge if possible. Revit has a 20 Mile diameter display limitation. Elements falling outside of and models larger than this range will cause graphical errors.

C. Link CAD files using the line weight mapping file *importlineweights-dwg-ACCD.txt*

D. Survey CAD files require an individual work set. Refer to "ACCD Procedure – Geo-Location, Shared Coordinates and Civil 3D" establishing shared coordinates with a civil survey CAD file.

E. Verify naming convention is according to BIM PxP.

F. Verify the units, precision, and coordinate system comply with the BIM PxP requirements.

G. Link using Auto – Center to Center, unless shared coordinate has been established.

H. Pin CAD Links.

4.2 CAD Details

A. Linking/importing CAD details into Revit increases file size and slows open and sync times. Create Revit versions of needed CAD details.

B. Never explode an imported CAD file in a project model.

4.3 Revit Links

A. Each linked Revit file will have a distinct work set.

B. Link model using "Auto – Origin to Origin" and pin.

C. Shared coordinates and project North rotation shall be used for sites with multiple modeled buildings. Do not deviate without BIM project coordinator consent.

D. Ownership of elements shall be properly communicated and tracked (floors may be created by the architectural team, and then adopted by the structural team).

E. Data produced by an author and may not suit the needs of team. In the case of dispute, relevant parties shall convene with the Digital Practice Manager(s) to discuss potential re-allocation of ownership.

F. Protocols for the use of COPY/MONITOR will be managed through discussions between disciplines.

G. The exchange protocol for linking external Revit files are defined in the ACCD PxP.

4.4 Exporting

A. The BIM process requires the use of 3D models to share modeled data. Revit serves as the main repository for modeled data at ACCD. During design, exported data from the Revit model can be used for clash detection and engineering analysis. During construction and operation, exported model data can be used to perform site utilization planning, digital fabrication, asset management, and cost estimation.

B. Design collaboration, visualization, and simulation, are possible with a multitude of BIM capable software, and data in the Revit model can be exported to many formats.

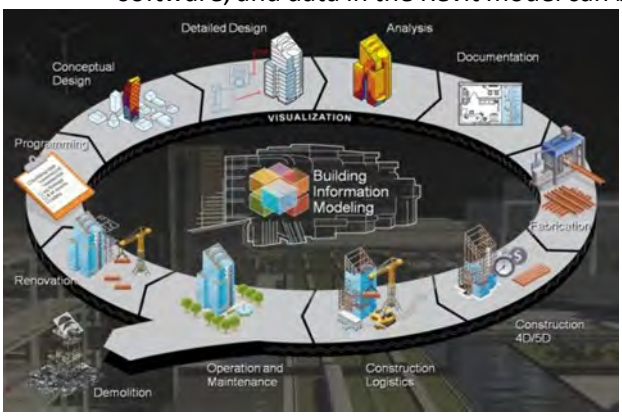


Figure 2: Design Collaboration

C. References

CAD

Refer to ACCD Exporting Files from Revit documentation.

Navisworks

Refer to ACCD Procedure: ACCD Navisworks Clash Detection.

PART 5 - Modeling

5.1 Modeling Standard

A. Establish true North and shared coordinates as soon as possible.

B. Project units are set to 1/256” tolerance. Elements shall be accurately modeled and within tolerance. In tolerance dictates that elements are to be located in exact positions.

C. Family content must meet standards outlined in the Creating Revit Content/Families section.

D. Over-Modeling slows the responsiveness of the model with no payback. Consult with the project’s BIM project coordinator or Digital Practice Manager and use the following rules of thumb.
1. Model features that are included on a 1/4”=1’0” scaled drawing.
2. If modeling is time intensive and affects two or less views, 2D detailing is appropriate.
3. Verify LOD defined in a project’s BIM PxP.

5.2 3D Datum (Grids, Levels, Reference Planes)

A. Grids – Shall be placed on the appropriate discipline ‘Shared Grids’ Workset and pinned.

B. Levels – Shall be placed on the appropriate discipline ‘Shared Levels’ Workset and pinned.

C. Reference Planes – Are to be named appropriately. Unnamed Reference Planes will be deleted.

5.3 Level of Development (LOD)

A. AIA Document G202-2013 Building Information Modeling Protocol Form defines LOD as a system that describes the minimum dimensional, spatial, quantities, qualitative and other data included in a model to support a BIM use, such as digital fabrication and asset management. The LOD definition chart below describes the five LOD’s.

Table 8

	LOD DEFINITION	Location	Quantities	Loads / Construction Analysis	Cost	Schedule / CM	Description / Example
ACCD BASIC DESIGN SERVICE	**100 – Conceptual / Symbolic** The model element may be graphically represented in the model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the model element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other model elements.	✓					
	200 - Approximate Geometry The model element is graphically represented within the model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the model element.	✓	✓		✓		
	300 - Precise Geometry The model element is graphically represented within the model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the model element.	✓	✓	✓	✓	✓	
GC	**400 – Fabrication** The model element is graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model element.	✓	✓	✓	✓	✓	✓ ✓
FM	**500 - As-Built** The model element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the model elements.	✓	✓	✓	✓	✓	✓ ✓

This document references Level of Development (LOD). A separate but similar system called Level of *Detail* is also commonly referred to as "LOD." Level of Detail describes the detail included in a model element

whereas Level of Development is the reliability of the information in the modeled element." In essence, Level of Detail refers to input and Level of Development refers to reliable output.

B. ACCD Minimum Modeling Matrix uses LOD to describe the completeness of model elements at end of the construction documentation phase. This matrix is included with ACCD BIM PxP.

Element ID	Part of Project Scope	LOD	GRADE	Model Author(s)	Description
SUBSTRUCTURE	No	•	•	Structural	
FOUNDATIONS	Yes	•	•	Structural	
Standard Foundations	Yes	•	•	Structural	
Wall Foundations	Yes	300	3D+	Structural	
Column Foundations	Yes	300	3D+	Structural	
Standard Foundation Supplementary Components	Yes	200	2D-	Structural	
Special Foundations	Yes	•	•	Structural	
Driven Piles	Yes	300	3D+	Structural	
Bored Piles	Yes	300	3D+	Structural	
Caissons	Yes	300	3D+	Structural	

Figure 3: ACCD Minimum Modeling Matrix

5.4 ACCD Minimum Model Requirements

A. This guideline clarifies minimum model requirements per discipline. The model may vary in LOD for individual elements, but at minimum the features typically included on quarter inch (1/4"=1'0") scaled drawings will be modeled. The word "modeled" refers to both 2D and 3D elements in this section.

B. Architectural / Interior

1. Rooms: Modeled with the necessary intelligence to produce accurate schedules, including name, number, room finishes, area, program area and department (if applicable).
2. Walls and Curtain Walls: Modeled to actual height, length, width, and location with indications for acoustic and fire ratings.
3. Doors, Windows and Louvers: Modeled to actual size, type and location. Doors and windows include the necessary intelligence to produce accurate schedules.
4. Roof: Roof configuration, drainage system, penetrations, and specialties, are modeled to produce accurate plans, building sections and generic wall sections.
5. Floors: Floor materials, penetrations and other special conditions are modeled to produce accurate plans, buildings sections and generic wall sections.
6. Expansion/Contraction Joints: Architectural expansion/contraction joints may be depicted using model lines or by creating separate geometry on each side of joint.
7. Ceilings: Ceiling dimensions, soffits, materials, and special conditions are modeled to produce accurate plans, building sections and generic wall sections.
8. Vertical Circulation: Continuous vertical components (non-structural shafts, architectural stairs, handrails and guardrails) are modeled to produce accurate plans, elevations and sections. Elevator Shaft, cab, and overrun shall be modeled to produce accurate plans, elevations, and sections.

9. Architectural Specialties and Woodwork: Architectural specialties (toilet room accessories, toilet partitions, grab bars, lockers, display cases) and woodwork (cabinetry and counters) are modeled to produce accurate plans, elevations and sections and include the necessary intelligence to produce accurate schedules.
10. Signage: Code required signage will be modeled to produce accurate plans and schedules.

C. Furniture/Fixtures/Equipment (if included in contract)
1. Furniture: Office equipment and furniture systems are modeled to actual size and location to produce accurate plans, sections, perspectives and elevations, with the necessary intelligence to produce accurate schedules, including materials, finishes, mechanical, and electrical requirements.
2. System Coordination: Furniture that includes power, communications, data, plumbing or other features will include the necessary intelligence to produce coordinated documents.
3. Fixtures and Equipment: Modeled to produce accurate plans, elevations, sections and schedules.

D. Structural
1. Foundations: Foundation and footing elements are modeled to produce accurate plans and elevations.
2. Floor Slabs: Recesses, curbs, pads, closure pours, and major penetrations are modeled accurate for size and location.
3. Structural Steel: Steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks) are modeled to produce accurate structural framing plans and related building/wall sections.
4. Cast-in-Place Concrete: Walls, columns, and beams are modeled to produce accurate plans and building/wall sections.
5. Concrete Reinforcement: Rebar is not modeled in 3D as part of ACCD basic BIM services.
6. Expansion Joints: Expansion joints are modeled by creating separate geometry on either side of joint.
7. Stairs: Structural framing members required for support of stairs, (and not part of delegated stair design work scope), are modeled to produce accurate plans, building sections, and wall sections.
8. Shafts and Pits: Shafts, pits, and openings are modeled to produce accurate plans, building sections, and wall sections.

E. Mechanical
1. Pipes: Field-routed piping less than 1-1/2”Ø nominal are modeled, but located diagrammatically and not coordinated to be clash free.
2. HVAC: Heating, ventilating, air-conditioning and specialty equipment, including air distribution ducts, registers, diffusers, grills and baseboards are modeled to produce accurate plans, elevations, sections and schedules. Mechanical equipment, and related equipment, are modeled to produce accurate plans, elevations, sections and schedules.

3. Plumbing: Plumbing fixtures, drains, and related equipment are modeled to produce accurate plans, elevations, sections and schedules.
4. Equipment Clearances: HVAC and plumbing equipment clearances are modeled for interference management and maintenance access.
5. Equipment Pads: Mechanical pads are modeled to the same requirements as floors in B.5 – ARCHITECTURAL/INTERIOR.

F. Electrical/Telecommunications
1. Conduits: Conduit less than 4"Ø nominal is not modeled.
2. Power: Receptacles, panelboards, switchgear, transformers, and associated equipment are modeled to produce accurate plans, elevations, sections, details, and schedules.
3. Lighting: Lighting fixtures, panelboards, switchgear, transformers, controls, and associated equipment are modeled to produce accurate plans, elevations, sections, details, and schedules.
4. Telecommunications and Special Systems: Telecommunications, cable tray, security, mass notification, public address, nurse call, and other special systems are modeled to produce accurate plans, details, and schedules.
5. Grounding Systems: Grounding components, lightning protection systems, static grounding systems, communication grounding systems, and bonding are modeled to produce accurate plans, details, and schedules.
6. Equipment Clearances: Electrical and communications clearances are modeled for interference management, working space, and maintenance access.
7. Equipment Pads: Electrical equipment pads are modeled to the same requirements as floors in model.

G. Fire Protection
1. Fire Protection System: Fire protection components, pumps, tanks, and control panels are modeled to produce accurate plans, elevations, sections, and schedules.
2. Fire Alarms: Fire alarm, mass notification devices, and detection systems are modeled to produce accurate plans, elevations, and sections.

H. Civil
1. Civil elements are not modeled. Civil DWG files are linked into the model for coordination.

PART 6 - Documentation

6.1 Set Content and Order (Discipline Series Organization)

A. Sheet sets are organized by ACCD discipline and sequence number in compliance with National CAD Standard sheet organization guidelines.

6.2 Sheet Identification and Sheet Numbering

A. Sheets are organized by in compliance with National CAD Standard sheet organization guidelines.

6.3 E3 - Title Blocks (Sheet Specific)

A. Sheet specific title block information can be edited graphically. Project information (consistent on all sheets) is edited using the 'Project Information' tool, found on the 'Manage' tab in the 'Settings' pane.

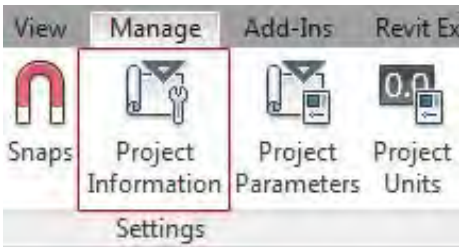


Figure 4: Project Information Tool

B. Consultant title, name and address are listed in the Project Properties dialog in the "Text" section. Shown in the title block below the ACCD logo, the visibility of these fields is controlled by the type parameters of the sheet.

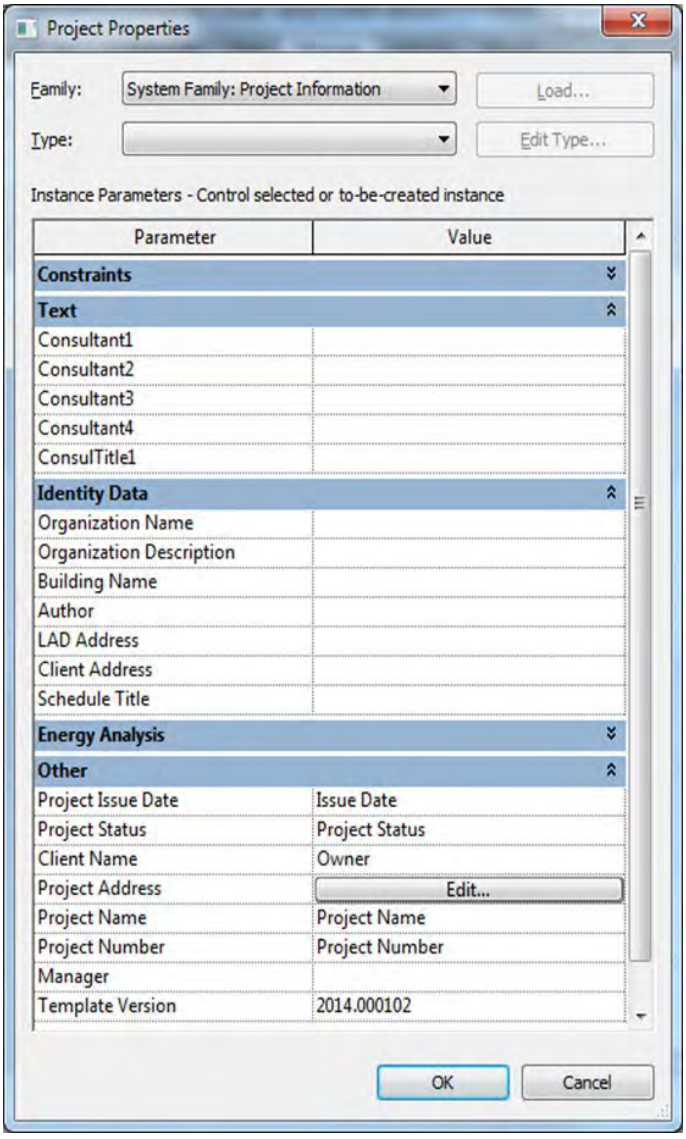


Figure 5: Project Properties Dialog

C. The Project properties dialog also contains fields for project name, number and address, project manager, client name and address, project status, issue date, and template version. The template version identifies the initial template and should not be edited.

6.4 Title Blocks (Project Specific)

A. Project-specific parameters (project status, location, etc.) are controlled by type properties in the title block. Parameters with a check mark are shown in all title blocks of that type.

B. Sheet-specific parameters (key plans, detail grids, etc.) are controlled by instance properties in the Properties palette when the title block is selected. Parameters with a check mark are shown on specifically on that sheet.

C. The 'Identity Data' group contains the sheet name, sheet number, issue date, checked by, designed by, and approved by parameters.

D. The "Sheet Issue Date" displays only on 8 ½"x11" and 11"x17" title blocks for sheets issued independent of the main project (addenda, ASI, RFI, RFP and change orders). The "Project Issue Date" found in the project information dialog displays on full size title blocks.

E. The "Details 5x6" instance parameter is used to display guide lines that define detail locations on non-plan sheets.

6.5 Key Plan

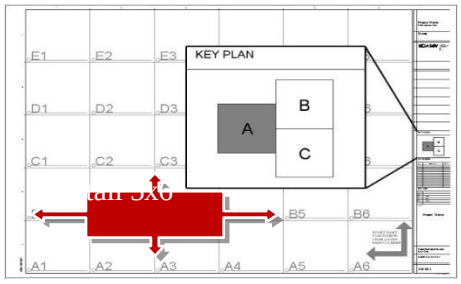


Figure 6: Key Plan

A. The ACCD title block family includes a sample key plan, controlled by instance parameters. Edit the title block family to customize the project key plan per project.

6.6 VIEWS, ANNOTATING, AND DETAILING

A. The content in project templates represent the ACCD graphics standard, and is based on the National CAD Standard. The ACCD Revit content library contains additional content. PART 11 - Appendix 01: Graphics Standard for illustration.

B. Use detail components in lieu of detail lines.

C. Templates contain design schedules and a selection of drawing schedules.

D. Use tags that read model element properties, not text.

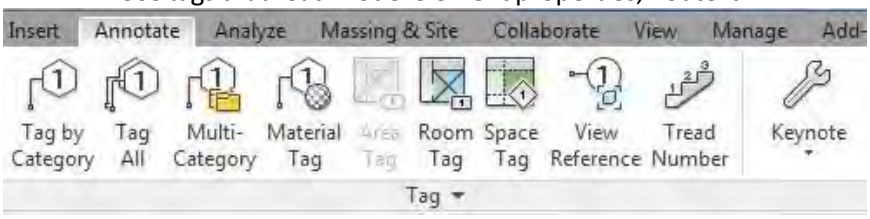
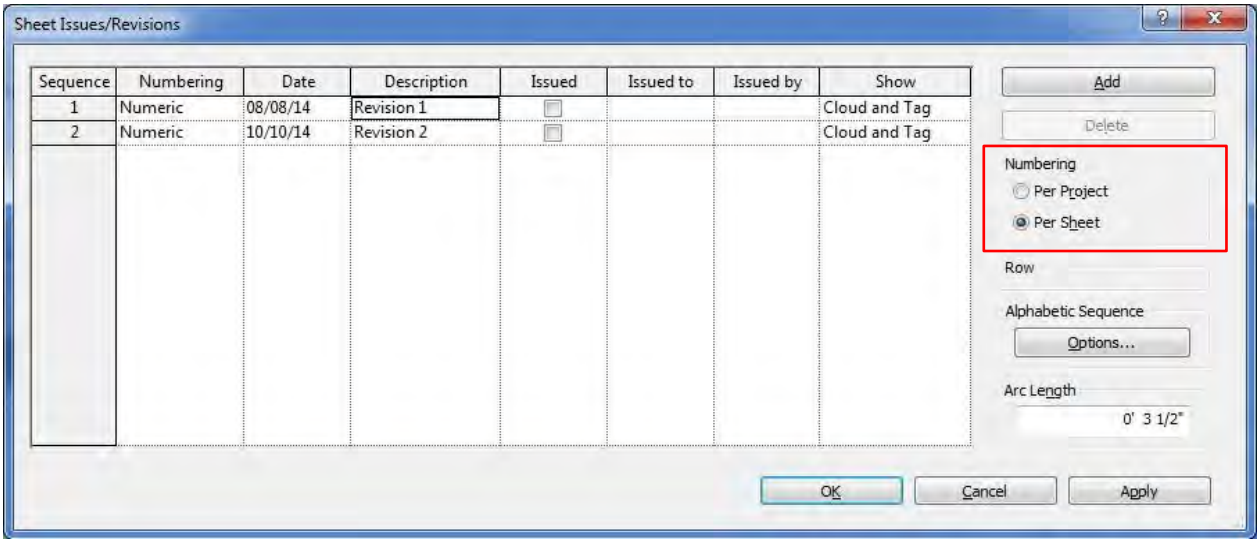


Figure 7: Annotation

6.7 Revisions



A. Standard revision numbering is per sheet. Issue entire sheets for revision whenever possible.

Figure 8: Sheet Numbering

PART 7 - QA/QC Tools

A. Project templates include QA/QC views and schedules. The table below describes the purpose of each QA/QC view and schedule.

7.2 F1 - QA/QC Views

Table 9

View Names	Purpose
90 – QAQC/ 3D Views/ Analysis	
SITE FORCES – SUMMER SOLSTICE	Visual analysis of shading/sun angle at summer solstice
SITE FORCES – WINTER SOLSTICE	Visual analysis of shading/sun angle at winter solstice
Coordination	
ISOLATE ELEC	3D view isolating electrical elements for visual check

ISOLATE GENERIC MODEL ELEMENTS	3D view isolating generic model elements
ISOLATE HVAC	3D view isolating HVAC elements for visual check
ISOLATE MODEL LINES	3D view isolating model lines for visual check
ISOLATE PLUMBING	3D view isolating plumbing elements for visual check
MEP COORDINATION	3D view with MEP/structural isolated and color coded
WALLS – EXT V. INT	3D view with walls isolated and color coded by use
WALLS – STRUCT V. ARCH	3D view with structural and arch isolated and color coded
Floor Plans/ Coordination	
RATED WALL COORDINATION – LEVEL 1	Walls are shown with fire rating, rated doors are red
ROOM COORDINATION – LEVEL 1	Rooms have Interior fill and reference visible
SPACE COORDINATION PLAN - LEVEL 1	Spaces have Interior fill and reference visible
SCOPE BOX COORDINATION – LEVEL 1	Scope boxes are visible and labeled with red text
STRUCTURAL GRID COORDINATION	St Grids isolated for management of location
GEOMETRIC PLAN	Guidelines driving building geometry captured
LEVEL COORDINATION	Levels Isolated for management of location
SLAB EDGE COORDINATION	Slabs visually isolated for management of slab edges

7.3 QA/QC Schedules

Table 20

Schedule Names	**Purpose**
90 - QAQC - DETAIL ITEMS	Track and manage detail Item families in project
90 - QAQC - FAMILY LIST	Track and manage all families in project
90 - QAQC - GENERIC MODEL ELEMENTS	Track and manage all generic model elements in project
90 - QAQC - MODEL MANAGER WEEKLY CHECKLIST	Track model maintenance activities
90 - QAQC - REVIEWER COMMENTS AND COORDINATION SCHEDULE	Track comments from file/drawing reviews within model
90 - QAQC - SHEET MANAGER LIST	Track and manage sheets in project
90 - QAQC - VIEW LIST	Track and manage views in project
90 - QAQC - WALL TYPE SCHEDULE	Manage and eliminate redundant wall types

PART 8 - Archive and Upgrade

A. Archive

1. Create an archive of the central model at milestone events and prior to major design changes. Set the archived version to READ ONLY and do not further modify it. The archived file is a resource for back checking and element recovery.
2. Major design changes include:
   a. Creation and completion of design options.
   b. Change of Revit version.
   c. Changing project phases or different events in the contract.

B. Upgrade

1. Active projects should be in the latest version of Revit. As new versions are deployed, project teams should discuss and schedule an upgrade. Upgrades should occur as soon as practical, giving consideration to project deadlines, consultants, partners, vendors, and other ACCD offices ensuring that all parties are prepared to upgrade at the same time.

PART 9 - Naming Conventions

9.1 Annotation Naming Conventions

Annotation Family File Naming Convention

1. Families must have unique names.
2. The leading letters in the family name will be capitalized.
3. Names should be kept as short as possible.
4. Separate the format fields with an underscore (_), no spaces around the underscore.
5. No special characters in file names (~!@#$%^&*()+'/"{}[])

B. Format: [Use or Description] _[Modifier]_ [Author or Standard]

Table 31

Identifier	**Description**	
Use or Description	A word(s) that describes the object: Tag, Symbol, Spot Elevation, Spot Coordinate, Keynote, Grid Head, etc	Required
Modifier	A word(s) that further describe the family: North Arrow, Center Line, Window, Type, Instance, Large, Circle, etc.	Required
Author or Creator	NCS, FAA, USACE, etc.	Optional

C. Examples:

1. Tag_Window_Type_NCS.rfa Symbol_Weld_NCS.rfa
2. Grid Head_Circle_NCS.rfa Titleblock_22x34_NCS.rfa

D. Annotation Type Naming Convention

1. Annotation type names contain only the modifier portion of the naming format.

Table 42

Annotation Family	**Type Naming Examples**
Tag_Window_Type_NCS.rfa	Window Tag
Symbol_Weld_NCS.rfa	Bottom, Top, Both
Grid Head_Circle_LAD.rfa	New, Existing
Titleblock_22x34_LAD.rfa	LAD 22x34

9.2 Model and Detail Component Naming Conventions

A. Family File Naming Convention
1. Families must have unique names.
2. Use natural language to describe the family in real world terms.
3. The leading letters in the family name will be capitalized.
4. Avoid abbreviations, if required reference LAD standard abbreviations.
5. Names should be kept as short as possible.
6. Separate the format fields with an underscore (_), no spaces around the Underscore.
7. No special characters in file names, except for dashes (~!@#$%^&*()+'/"{}[]…)
8. Type catalog files must share the same name as the family.

B. Format: [12 34 56]–[00]_[Use or Description]_[Modifier]_[Author or Creator]_[Sequence Option]_[2D]

Table 53

Identifier	**Description**	
12 34 56	6-digit CSI Numbering	Required
00	CSI sub number	Optional
Use or Description	A word(s) that describes the object: Table, Chair, etc.	Required
Modifier	A word(s) that further describes the family: Fixed Shelves, Boat Shaped, Overhead, Base, etc.	Required
Author/Creator/Source	LAD, Autodesk, Manufacturer, Reed, Sweets	Required
Sequence Option	Distinguish near identical families with a capital letter.	Optional
2D	2D families suffix "_2D" otherwise, 3D is assumed.	If Applicable

C. Examples:
1. 10 28 00_Grab Bar_L-Bobrick_A.rfa
2. 10 28 00_Grab Bar_L-Bobrick_B.rfa
3. 10 28 00_Grab Bar_L-Bobrick_LAD_A.rfa
4. 10 28 00_Grab Bar_L-Bobrick_LAD_A_2D.rfa

D. Type Naming Convention
1. Type names should clearly indicate usage.
2. Do not include family name or category in the type name.
3. Keep type names short enough to display in dialogs and the type selector.
4. All families must include at least one predefined type. "Type 1" is the default type name.
5. Type names should indicate the key differences between types (size, configuration, material).
6. Type names should include units or capacity and a unit indicator, unless nominal sizes.
7. Avoid the use of individual letters or words like h, w, d, or height, width, depth.

E. Format: [Model]_[Size or Dimensions]_[Modifier]_[Finish and/or Options]

Table 64

Identifier	Description
Model	Use the manufacturer's model number if this family represents a particular product, otherwise omit.
Size or Dimensions	Use the following general order in type names: • For doors and windows: <width> x <height> • For casework and furniture: <width> x <depth> x <height> • For other element types: <width> x <depth> • For families with most sizes under 10': XX" x YY" • For families with most sizes over 10': XX' – YY" x AA' – BB" • For metric families: XXXXmm x YYYYmm (or local standard) • For nominal sizes or industry-standard types, drop dimension indicators (",', or mm) and/or use industry-standard naming conventions. o Brick : Common, Norman, CSR, Metric Modular o Lumber : 2x4 o Structure : W12 x 204
Modifier	A word(s) that further describes the type: 3 Lite, 2 Drawer, etc.
Finish and/or Options	When type is defined by finish or material, include it in the type name. Do not include if material is an instance parameter.

F. Examples:
1. 36" x 48
2. B262
3. 10'-0" x 8'-0"

9.3 Revit Family Creation Rules

A. General
1. Contact a Digital Practice Manager for project specific requirements or unusual conditions.

B. Categories
1. Families created with the generic template must be assigned a category or generic subcategory.

C. Predefined types:
   1. All families must include one predefined type. “Type 1” is the default type name. Families available in standard sizes should have predefined types.
   2. Where there are more than 6 predefined types in a family a type catalog may be used to organize the types.

D. Parameter Naming Convention:
   1. Parameters (shared, family, project, and calculated) shall be prefixed with "**LAD_**".
   2. Key name in key schedules shall be prefixed with "**KEY_**".
   3. The first letter of each word in the parameter name is capitalized; other letters are lower case, with underscores between words.
      a. Ex.) ACCD_Parameter_Name
      b. EX.) KEY_Parameter_Name

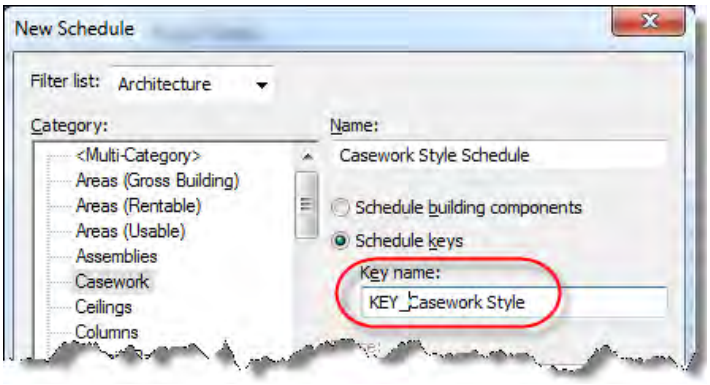


Figure 9: Parameter Naming Convention

E. Parameter Usage
   1. See the ACCD Family Technical Guide for parameter usage.
   2. Use standard parameters only.
   3. Create new parameters only when absolutely necessary, and after alerting the Digital Practice Manager group and documenting in the ACCD Revit Family Technical Guide.

F. Complexity
   1. Avoid 3D detail. Use 2D plan or elevation representations to enhance detail if required.
   2. Use scale dependent representation only where meaningful and check view scales to ensure the correct elements are visible.

G. Element Visibility
   1. Symbolic elements should not duplicate cuts or projections of 3D elements.
   2. Check views to ensure symbology is displayed appropriately.

H. Reference Planes and Reference Lines
   1. Main object edges and centerlines should be associated to reference planes.

2. Set “Is Reference” parameter as required, especially for “Strong” and “Not a Reference” situations.

I. Hosts
1. Make host objects large enough to accommodate variations of the family.
2. Only use floor host when the element changes the floor or removes floor volume.
3. Enable work plane-based parameter on elements installed on sloping floors.

J. Material Assignments
1. Assign materials present in the Revit libraries only, without modification.
2. Maintain consistent material use between families when applicable.

K. Thumbnail View
1. Create a view and name it “Preview” to provide a recognizable thumbnail image for the family. Preferably, use the following view types;
   a. For door/window/cabinets, use an exterior elevation view and turn off the wall host.
   b. For ceiling based family, use a 3D view and make the ceiling material 50% transparent.
   c. For furniture, use a 3D view.
   d. For 2D families, use a view that best represents the object (plan or elevation).
   e. For a recessed in wall family, use a 3D view and make the wall material 50% transparent.
   f. Temporarily hide annotation categories, connectors, and light sources in the preview view.

PART 10 - File Maintenance

10.1 BIM project coordinators conduct Revit file maintenance tasks as required for the project. A backup person familiar with project specifics should be identified to fill in as necessary. Some tasks require exclusive access to the central file(s) precluding team access to the files during the process.

Table 75

Frequently	**Task**
Daily	Review of Warnings –In a local file, reviewing and resolving warnings will help improve overall performance. Most single model collisions can be identified in this review.
Weekly	Room Maintenance – In Room Coordination view, check for overlapping rooms, areas with no rooms, and unenclosed areas.
Weekly	Space Coordination – Use "00-Space Schedule" to compare level, upper limit and limit offset parameters. Verify upper limit is set to the level above the associated level.
Weekly	Coordination Review – If using Revit for coordination with other disciplines and/or consultants. (The BIM project coordinator leads the creation of

	reports and the team's analysis and resolution).
Per BIM PxP	Interference Checking/ Review of Collisions - Check for collisions within the source file and linked files. Coordinate major building elements and systems. Larger projects may require Navisworks for this process.
Weekly	Project Browser Cleanup – Removal of views with no assigned view category under the "???" folder. Remove unused or unnecessary sheets. Removal of sheets from multi-discipline projects without consulting the project team is not advised. When in doubt ask the project team.
Monthly	Purge – Remove unused elements to improve performance and reduce file size. Before purging, it is recommended that a backup is created. It is not recommended to purge revision clouds, dimension styles, or other standard families that may be required in a later phase.
Every 2 Weeks	Audit – Scans, detects, and fixes corrupt elements in the project. The scheduled audit intervals are set by the project needs defined in the project kick off meeting. Revit may automatically delete corrupted elements, in which case, the BIM project coordinator will notify users.
Every 2 Weeks	Compact Central – Reduces file size. This process takes longer than a normal save, perform this action only when time allows.
Prior to Submittal	Update title block – Update title block family and transfer project standards.

PART 11 - Appendix 01: GRAPHICS Standard

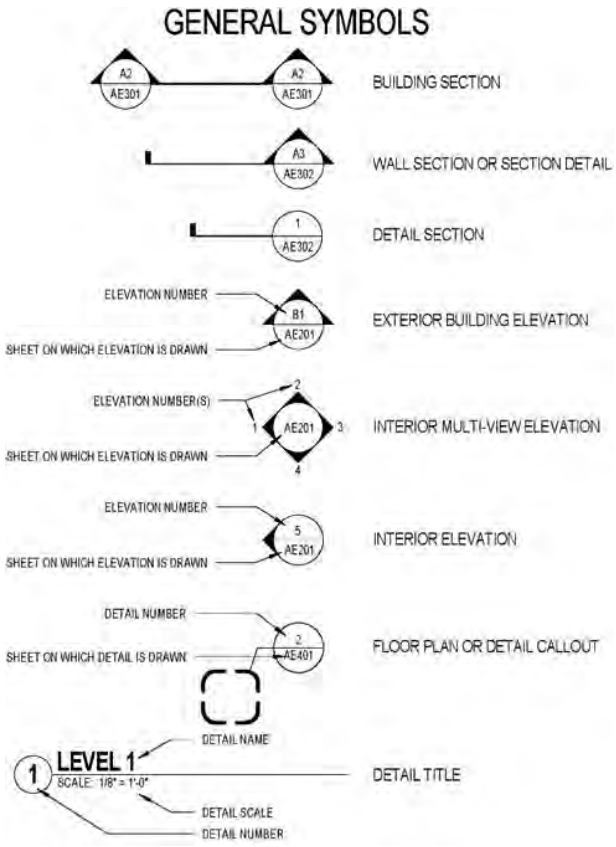


Figure 10: Symbols Standards

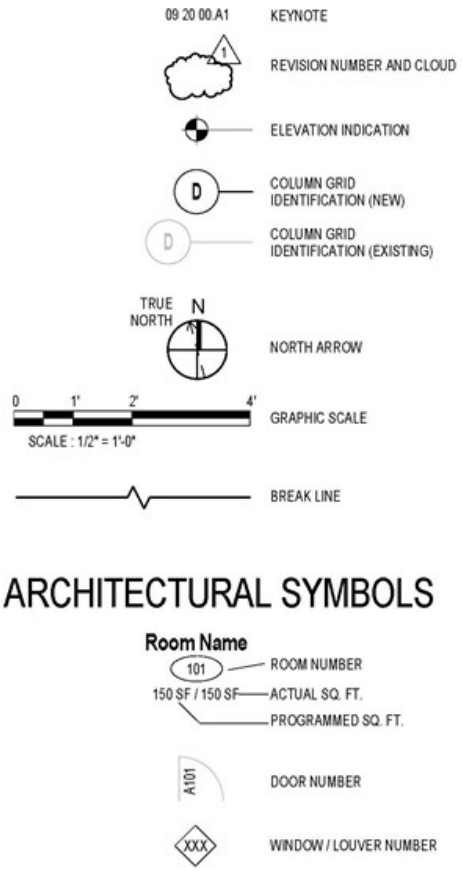


Figure 11: Symbols Standards

END OF SECTION 00 00 08-01

SECTION 00 00 08-02 – BIM STANDARDS LEVEL OF DEVELOPMENT

PART 1 - General

1.1 The Level of Development (LOD) standard is to be used in conjunction with the BIM Standard for Alamo Colleges.

A. The following LOD descriptions identify the specific element requirements for each Model Element.

LOD	Definition
•	Refer to the specific child element for appropriate LOD. (Used for categories that have multiple sub-elements for which varying LOD apply.)
100	Model Elements indicative of area, height, volume, location, and orientation may be modeled geometrically (i.e., a pump would be a cube.) or represented by a 2D component or other data in a detail (i.e., Detail Component)
200	Model Elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements (i.e., a pump would be a generic pump of approximate size.)
300	Model Elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location, and orientation. Non-geometric information may also be attached to Model Elements. Accurate to the degree dimensioned or indicated on contract documents (i.e., a pump would be a generic pump of accurate size complete with connections and clearances for a complete system.)

B. Within each Level of Development, there is the potential to represent information in various formats. In practice, it has been proven that there are certain elements for which there is a greater benefit in providing 3-dimensional representation, while in others drafting or representation in the form of narratives is sufficient for a particular deliverable.

Grade	Description
3D+	3D + Facility Data
2D+	2D + Facility Data
2D-	2D Only (Drafting, linework, text, and or part of an assembly)
-	Not included in or tied to the model (however is still required in the deliverable)
•	Refer to the specific child element for appropriate Grade. (Used for categories that have multiple sub-elements for which varying Grades apply.)

PART 2 - Minimum Modeling Matrix

1.2 The following pages indicates the minimum modeling requirements for projects with the Alamo Colleges.

MINIMUM MODELING MATRIX					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	OmniClass ID	UniFormat ID	Master Format ID	Element ID	LOD	GRADE	Primary Discipline (This will allow design team to identify discipline specific areas of content)
Level 1	21-01 00 00	A		SUBSTRUCTURE	•	•	Structural
Level 2	21-01 10	A10		FOUNDATIONS	•	•	Structural
Level 3	21-01 10	A1010		Standard Foundations	•	•	Structural
Level 4	21-01 10 10	A1010.10		Wall Foundations	300	3D+	Structural
Level 4	21-01 10 10 10	A1010.30		Column Foundations	300	3D+	Structural
Level 4	21-01 10 10 30	A1010.90		Standard Foundation Supplementary Components	200	2D-	Structural
Level 3	21-01 10 20	A1020	31 60 00	Special Foundations	•	•	Structural
Level 4	21-01 10 20 10	A1020.10	31 62 00	Driven Piles	300	3D+	Structural
Level 4	21-01 10 20 15	A1020.15	31 63 00	Bored Piles	300	3D+	Structural
Level 4	21-01 10 20 20	A1020.20	31 64 00	Caissons	300	3D+	Structural
Level 4	21-01 10 20 30	A1020.30	31 66 16	Special Foundation Walls	300	3D+	Structural
Level 4	21-01 10 20 40	A1020.40	31 68 00	Foundation Anchors	100	2D-	Structural
Level 4	21-01 10 20 50	A1020.50	31 48 00	Underpinning	100	2D-	Structural
Level 4	21-01 10 20 60	A1020.60	03 71 00	Raft Foundations	300	3D+	Structural
Level 4	21-01 10 20 70	A1020.70		Pile Caps	300	3D+	Structural
Level 4	21-01 10 20 80	A1020.80		Grade Beams	300	3D+	Structural
Level 2	21-01 20	A20		SUBGRADE ENCLOSURES	•	•	Architectural, Structural
Level 3	21-01 20 10	A2010		Walls for Subgrade Enclosures	•	•	Architectural, Structural
Level 4	21-01 20 10 10	A2010.10		Subgrade Enclosure Wall Construction	300	3D+	Architectural, Structural
Level 4	21-01 20 10 20	A2010.20		Subgrade Enclosure Wall Interior Skin	300	3D+	Architectural
Level 4	21-01 20 10 90	A2010.90		Subgrade Enclosure Wall Supplementary Components	200	2D-	Architectural, Structural
Level 2	21-01 40	A40		SLABS ON GRADE	•	•	Structural
Level 3	21-01 40 10	A4010		Standard Slabs-on-Grade	300	3D+	Structural
Level 3	21-01 40 20	A4020		Structural Slabs-on-Grade	300	3D+	Structural
Level 3	21-01 40 30	A4030		Slab Trenches	300	3D+	Architectural, Structural
Level 3	21-01 40 40	A4040		Pits and Bases	300	3D+	Architectural, Electrical, Equipment, Fire Protection, Mechanical (HVAC), Plumbing, Structural

MINIMUM MODELING MATRIX

					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 3	**21-01 40 90**	**A4090**		**Slab-On-Grade Supplementary Components**	•	•	Structural
Level 4	**21-01 40 90 10**	**A4090.10**	**07 21 00**	**Perimeter Insulation**	300	3D+	Architectural
Level 4	**21-01 40 90 20**	**A4090.20**	**07 26 00**	**Vapor Retarder**	100	2D+	Architectural
Level 4	**21-01 40 90 30**	**A4090.30**	**07 10 00**	**Waterproofing**	100	2D+	Architectural
Level 4	**21-01 40 90 50**	**A4090.50**	**03 30 00**	**Mud Slab**	300	3D+	Structural
Level 4	**21-01 40 90 60**	**A4090.60**	**31 23 23**	**Subbase Layer**	100	2D+	Structural
Level 2	**21-01 60**	**A60**		**WATER AND GAS MITIGATION**	•	•	Plumbing, Specialty Consultants
Level 3	**21-01 60 10**	**A6010**	**33 46 00**	**Building Subdrainage**	•	•	Architectural
Level 4	**21-01 60 10 10**	**A6010.10**	**33 46 13**	**Foundation Drainage**	100	2D+	Architectural
Level 4	**21-01 60 10 20**	**A6010.20**	**33 46 19**	**Underslab Drainage**	100	2D+	Architectural
Level 3	**21-01 60 20**	**A6020**	**31 21 00**	**Off-Gassing Mitigation**	•	•	Plumbing
Level 4	**21-01 60 20 10**	**A6020.10**	**31 21 13**	**Radon Mitigation**	100	2D-	Plumbing
Level 4	**21-01 60 20 50**	**A6020.50**	**31 21 16**	**Methane Mitigation**	100	2D-	Plumbing
Level 2	**21-01 90**	**A90**		**SUBSTRUCTURE RELATED ACTIVITIES**	•	•	Structural
Level 3	**21-01 90 10**	**A9010**	**31 23 16**	**Substructure Excavation**	•	•	Civil, Structural
Level 4	**21-01 90 10 10**	**A9010.10**	**31 23 23**	**Backfill and Compaction**	100	2D-	Structural
Level 3	**21-01 90 20**	**A9020**	**31 23 19**	**Construction Dewatering**	**100**	**2D-**	Civil, Specialty Consultants
Level 3	**21-01 90 30**	**A9030**	**31 50 00**	**Excavation Support**	•	•	Specialty Consultants
Level 4	**21-01 90 30 10**	**A9030.10**	**31 51 00**	**Anchor Tiebacks**	100	2D-	Specialty Consultants
Level 4	**21-01 90 30 20**	**A9030.20**	**31 52 00**	**Cofferdams**	100	2D-	Architectural, Specialty Consultants
Level 4	**21-01 90 30 40**	**A9030.40**	**31 53 00**	**Cribbing and Walers**	100	2D-	Specialty Consultants
Level 4	**21-01 90 30 60**	**A9030.60**	**31 54 00**	**Ground Freezing**	100	2D-	Specialty Consultants
Level 4	**21-01 90 30 70**	**A9030.70**	**31 56 00**	**Slurry Walls**	100	2D-	Specialty Consultants
Level 3	**21-01 90 40**	**A9040**	**31 31 00**	**Soil Treatment**	**100**	**2D-**	Specialty Consultants
Level 1	**21-02 00 00**	**B**		**SHELL**	•	•	Architectural, Structural
Level 2	**21-02 10**	**B10**		**SUPERSTRUCTURE**	•	•	Architectural, Structural
Level 3	**21-02 10 10**	**B1010**		**Floor Construction**	•	•	Architectural, Structural
Level 4	**21-02 10 10 10**	**B1010.10**		**Floor Structural Frame**	300	3D+	Structural
Level 4	**21-02 10 10 20**	**B1010.20**		**Floor Decks, Slabs and Topping**	300	3D+	Structural
Level 4	**21-02 10 10 30**	**B1010.30**		**Balcony Floor Construction**	300	3D+	Structural
Level 4	**21-02 10 10 40**	**B1010.40**		**Mezzanine Floor Construction**	300	3D+	Structural
Level 4	**21-02 10 10 50**	**B1010.50**		**Ramps**	300	3D+	Structural
Level 4	**21-02 10 10 90**	**B1010.90**		**Floor Construction Supplementary Components**	100	2D-	Architectural, Structural
Level 3	**21-02 10 20**	**B1020**		**Roof Construction**	•	•	Architectural, Structural

MINIMUM MODELING MATRIX

					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-02 10 20 10**	**B1020.10**		**Roof Structural Frame**	300	3D+	Structural
Level 4	**21-02 10 20 20**	**B1020.20**		**Roof decks, slabs and sheathing**	300	3D+	Architectural, Structural
Level 4	**21-02 10 20 30**	**B1020.30**		**Canopy Construction**	300	3D+	Architectural, Structural
Level 4	**21-02 10 20 90**	**B1020.90**		**Roof Construction Supplementary Components**	100	2D+	Architectural, Structural
Level 3	**21-02 10 80**	**B1080**		**Stairs**	•	•	Architectural
Level 4	**21-02 10 80 10**	**B1080.10**		**Stair Construction**	300	3D+	Architectural, Structural
Level 4	**21-02 10 80 30**	**B1080.30**		**Stair Soffits**	300	3D+	Architectural
Level 4	**21-02 10 80 50**	**B1080.50**		**Stair Railings**	300	3D+	Architectural
Level 4	**21-02 10 80 60**	**B1080.60**	**05 51 23**	**Fire Escapes**	300	3D+	Architectural
Level 4	**21-02 10 80 70**	**B1080.70**	**05 51 36**	**Metal Walkways**	300	3D+	Architectural
Level 4	**21-02 10 80 80**	**B1080.80**	**05 51 23**	**Ladders**	300	3D+	Architectural
Level 2	**21-02 20**	**B20**		**EXTERIOR VERTICAL ENCLOSURES**	•	•	Architectural
Level 3	**21-02 20 10**	**B2010**		**Exterior Walls**	•	•	Architectural, Structural
Level 4	**21-02 20 10 10**	**B2010.10**		**Exterior Wall Veneer**	300	3D+	Architectural
Level 4	**21-02 20 10 20**	**B2010.20**		**Exterior Wall Construction**	300	3D+	Architectural
Level 4	**21-02 20 10 30**	**B2010.30**		**Exterior Wall Interior Skin**	300	3D+	Architectural
Level 4	**21-02 20 10 40**	**B2010.40**		**Fabricated Exterior Wall Assemblies**	300	3D+	Architectural
Level 4	**21-02 20 10 50**	**B2010.50**		**Parapets**	300	3D+	Architectural
Level 4	**21-02 20 10 60**	**B2010.60**		**Equipment Screens**	300	3D+	Architectural
Level 4	**21-02 20 10 80**	**B2010.80**		**Exterior Wall Supplementary Components**	100	2D-	Architectural, Structural
Level 4	**21-02 20 10 90**	**B2010.90**		**Exterior Wall Opening Supplementary Components**	100	2D-	Architectural
Level 3	**21-02 20 20**	**B2020**	**08 50 00**	**Exterior Windows**	•	•	Architectural
Level 4	**21-02 20 20 10**	**B2020.10**	**08 50 00**	**Exterior Operating Windows**	300	3D+	Architectural
Level 4	**21-02 20 20 20**	**B2020.20**	**08 50 00**	**Exterior Fixed Windows**	300	3D+	Architectural
Level 4	**21-02 20 20 30**	**B2020.30**		**Exterior Window Wall**	300	3D+	Architectural
Level 4	**21-02 20 20 50**	**B2020.50**	**08 56 00**	**Exterior Special Function Windows**	300	3D+	Architectural
Level 3	**21-02 20 50**	**B2050**		**Exterior Doors and Grilles**	•	•	Architectural
Level 4	**21-02 20 50 10**	**B2050.10**	**08 42 00**	**Exterior Entrance Doors**	300	3D+	Architectural
Level 4	**21-02 20 50 20**	**B2050.20**	**08 10 00**	**Exterior Utility Doors**	300	3D+	Architectural
Level 4	**21-02 20 50 30**	**B2050.30**		**Exterior Oversize Doors**	300	3D+	Architectural
Level 4	**21-02 20 50 40**	**B2050.40**	**08 30 00**	**Exterior Special Function Doors**	300	3D+	Architectural
Level 4	**21-02 20 50 60**	**B2050.60**		**Exterior Grilles**	300	3D+	Architectural
Level 4	**21-02 20 50 70**	**B2050.70**		**Exterior Gates**	300	3D+	Architectural
Level 4	**21-02 20 50 90**	**B2050.90**		**Exterior Door Supplementary**	100	2D-	Architectural

MINIMUM MODELING MATRIX

					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
				Components			
Level 3	**21-02 20 70**	**B2070**	**08 90 00**	**Exterior Louvers and Vents**	•	•	Architectural
Level 4	**21-02 20 70 10**	**B2070.10**	**08 91 00**	**Exterior Louvers**	300	3D+	Architectural
Level 4	**21-02 20 70 50**	**B2070.50**	**08 95 00**	**Exterior Vents**	300	3D+	Architectural
Level 3	**21-02 20 80**	**B2080**		**Exterior Wall Appurtenances**	•	•	Architectural
Level 4	**21-02 20 80 10**	**B2080.10**	**10 82 13**	**Exterior Fixed Grilles and Screens**	300	3D+	Architectural
Level 4	**21-02 20 80 30**	**B2080.30**		**Exterior Opening Protection Devices**	100	2D-	Architectural
Level 4	**21-02 20 80 50**	**B2080.50**	**05 52 00**	**Exterior Balcony Walls and Railings**	300	3D+	Architectural
Level 4	**21-02 20 80 70**	**B2080.70**		**Exterior Fabrications**	300	3D+	Architectural
Level 4	**21-02 20 80 80**	**B2080.80**	**10 81 13**	**Bird Control Devices**	100	2D-	Architectural
Level 3	**21-02 20 90**	**B2090**	**10 74 00**	**Exterior Wall Specialties**	**300**	**2D+**	Architectural
Level 2	**21-02 30**	**B30**		**EXTERIOR HORIZONTAL ENCLOSURES**	•	•	Architectural
Level 3	**21-02 30 10**	**B3010**		**Roofing**	•	•	Architectural
Level 4	**21-02 30 10 10**	**B3010.10**	**07 30 00**	**Steep Slope Roofing**	300	3D+	Architectural
Level 4	**21-02 30 10 50**	**B3010.50**		**Low-Slope Roofing**	300	3D+	Architectural
Level 4	**21-02 30 10 70**	**B3010.70**		**Canopy Roofing**	300	3D+	Architectural
Level 4	**21-02 30 10 90**	**B3010.90**		**Roofing Supplementary Components**	100	2D+	Architectural
Level 3	**21-02 30 20**	**B3020**		**Roof Appurtenances**	•	•	Architectural
Level 4	**21-02 30 20 10**	**B3020.10**	**07 72 00**	**Roof Accessories**	300	3D+	Architectural
Level 4	**21-02 30 20 30**	**B3020.30**	**10 74 00**	**Roof Specialties**	200	2D+	Architectural
Level 4	**21-02 30 20 70**	**B3020.70**	**ND**	**Rainwater Management**	200	2D+	Architectural
Level 3	**21-02 30 40**	**B3040**		**Traffic Bearing Horizontal Enclosures**	•	•	Architectural
Level 4	**21-02 30 40 10**	**B3040.10**	**07 18 00**	**Traffic Bearing Coatings**	100	2D-	Architectural
Level 4	**21-02 30 40 30**	**B3040.30**	**07 10 00**	**Horizontal Waterproofing Membrane**	200	2D+	Architectural
Level 4	**21-02 30 40 50**	**B3040.50**		**Wear Surfaces**	100	2D-	Architectural
Level 4	**21-02 30 40 90**	**B3040.90**		**Horizontal Enclosure Supplementary Components**	100	2D-	Architectural
Level 3	**21-02 30 60**	**B3060**		**Horizontal Openings**	•	•	Architectural
Level 4	**21-02 30 60 10**	**B3060.10**	**08 60 00**	**Roof Windows and Skylights**	300	3D+	Architectural
Level 4	**21-02 30 60 50**	**B3060.50**		**Vents and Hatches**	300	3D+	Architectural
Level 4	**21-02 30 60 90**	**B3060.90**		**Horizontal Opening Supplementary Components**	100	2D-	Architectural
Level 3	**21-02 30 80**	**B3080**		**Overhead Exterior Enclosures**	•	•	Architectural
Level 4	**21-02 30 80 10**	**B3080.10**		**Exterior Ceilings**	300	3D+	Architectural
Level 4	**21-02 30 80 20**	**B3080.20**		**Exterior Soffits**	300	3D+	Architectural
Level 4	**21-02 30 80 30**	**B3080.30**		**Exterior Bulkheads**	300	3D+	Architectural

MINIMUM MODELING MATRIX

					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 1	**21-03 00 00**	**C**		**INTERIORS**	•	•	Architectural, Equipment, Interiors, Mechanical (HVAC), Plumbing
Level 2	**21-03 10**	**C10**		**INTERIOR CONSTRUCTION**	•	•	Architectural
Level 3	**21-03 10 10**	**C1010**	**10 22 00**	**Interior Partitions**	•	•	Architectural
Level 4	**21-03 10 10 10**	**C1010.10**		**Interior Fixed Partitions**	300	3D+	Architectural
Level 4	**21-03 10 10 20**	**C1010.20**		**Interior Glazed Partitions**	300	3D+	Architectural
Level 4	**21-03 10 10 40**	**C1010.40**	**10 22 19**	**Interior Demountable Partitions**	300	2D+	Architectural
Level 4	**21-03 10 10 50**	**C1010.50**		**Interior Operable Partitions**	300	3D+	Architectural
Level 4	**21-03 10 10 70**	**C1010.70**		**Interior Screens**	300	2D+	Architectural
Level 4	**21-03 10 10 90**	**C1010.90**		**Interior Partition Supplementary Components**	100	2D-	Architectural
Level 3	**21-03 10 20**	**C1020**	**08 50 00**	**Interior Windows (a.k.a borrowed lites)**	•	•	Architectural
Level 4	**21-03 10 20 10**	**C1020.10**	**08 50 00**	**Interior Operating Windows**	300	3D+	Architectural
Level 4	**21-03 10 20 20**	**C1020.20**	**08 50 00**	**Interior Fixed Windows**	300	3D+	Architectural
Level 4	**21-03 10 20 50**	**C1020.50**	**08 50 00**	**Interior Special Function Windows**	300	3D+	Architectural
Level 4	**21-03 10 20 90**	**C1020.90**	**08 50 00**	**Interior Window Supplementary Components**	100	2D-	Architectural
Level 3	**21-03 10 30**	**C1030**	**08 10 00**	**Interior Doors**	•	•	Architectural
Level 4	**21-03 10 30 10**	**C1030.10**	**08 10 00**	**Interior Swinging Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 20**	**C1030.20**	**08 10 00**	**Interior Entrance Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 25**	**C1030.25**	**08 42 00**	**Interior Sliding Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 30**	**C1030.30**	**08 11 73**	**Interior Folding Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 40**	**C1030.40**	**08 35 13**	**Interior Coiling Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 50**	**C1030.50**	**08 33 00**	**Interior Panel Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 70**	**C1030.70**	**08 36 00**	**Interior Special Function Doors**	300	3D+	Architectural
Level 4	**21-03 10 30 80**	**C1030.80**	**08 30 00**	**Interior Access Doors and Panels**	300	3D+	Architectural
Level 4	**21-03 10 30 90**	**C1030.90**	**08 31 00**	**Interior Door Supplementary Components**	100	2D-	Architectural
Level 3	**21-03 10 40**	**C1040**		**Interior Grilles and Gates**	•	•	Architectural
Level 4	**21-03 10 40 10**	**C1040.10**		**Interior Grilles**	300	3D+	Architectural
Level 4	**21-03 10 40 50**	**C1040.50**		**Interior Gates**	300	3D+	Architectural
Level 3	**21-03 10 60**	**C1060**		**Raised Floor Construction**	•	•	Architectural, Electrical
Level 4	**21-03 10 60 10**	**C1060.10**	**09 69 00**	**Access Flooring**	200	3D+	Architectural, Electrical
Level 4	**21-03 10 60 30**	**C1060.30**		**Platform/Stage Floors**	200	3D+	Architectural, Electrical
Level 3	**21-03 10 70**	**C1070**		**Suspended Ceiling Construction**	•	•	Architectural
Level 4	**21-03 10 70 10**	**C1070.10**	**09 51 00**	**Acoustical Suspended Ceilings**	300	3D+	Architectural

MINIMUM MODELING MATRIX

					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-03 10 70 20**	**C1070.20**		**Suspended Plaster and Gypsum Board Ceilings**	300	3D+	Architectural
Level 4	**21-03 10 70 50**	**C1070.50**	**09 54 00**	**Specialty Suspended Ceilings**	300	3D+	Architectural
Level 4	**21-03 10 70 70**	**C1070.70**	**09 57 00**	**Special Function Suspended Ceilings**	300	3D+	Architectural
Level 4	**21-03 10 70 90**	**C1070.90**		**Ceiling Suspension Components**	100	2D-	Architectural
Level 3	**21-03 10 90**	**C1090**		**Interior Specialties**	•	•	Architectural, Equipment, Mechanical (HVAC), Plumbing
Level 4	**21-03 10 90 10**	**C1090.10**		**Interior Railings and Handrails**	300	3D+	Architectural
Level 4	**21-03 10 90 15**	**C1090.15**	**08 91 00**	**Interior Louvers**	300	3D+	Architectural, Mechanical (HVAC)
Level 4	**21-03 10 90 20**	**C1090.20**	**10 10 00**	**Information Specialties**	200	2D+	Architectural, Electrical
Level 4	**21-03 10 90 25**	**C1090.25**	**10 21 00**	**Compartments and Cubicles**	100	2D-	Architectural, Interiors
Level 4	**21-03 10 90 30**	**C1090.30**	**10 25 00**	**Service Walls**	300	3D+	Architectural, Electrical, Plumbing
Level 4	**21-03 10 90 35**	**C1090.35**	**10 26 00**	**Wall and Door Protection**	100	2D-	Architectural
Level 4	**21-03 10 90 40**	**C1090.40**	**10 28 00**	**Toilet, Bath, and Laundry Accessories**	100	2D-	Architectural
Level 4	**21-03 10 90 45**	**C1090.45**	**10 84 16**	**Interior Gas Lighting**	200	3D+	Electrical, Interiors
Level 4	**21-03 10 90 50**	**C1090.50**	**10 30 00**	**Fireplaces and stoves**	200	3D+	Architectural
Level 4	**21-03 10 90 60**	**C1090.60**	**10 40 00**	**Safety Specialties**	200	3D+	Architectural, Interiors
Level 4	**21-03 10 90 70**	**C1090.70**	**10 50 00**	**Storage Specialties**	200	3D+	Architectural
Level 4	**21-03 10 90 90**	**C1090.90**	**10 80 00**	**Other Interior Specialties**	100	2D-	Architectural
Level 2	**21-03 20**	**C20**		**INTERIOR FINISHES**	•	•	Interiors
Level 3	**21-03 20 10**	**C2010**	**09 70 00**	**Wall Finishes**	•	•	Interiors
Level 4	**21-03 20 10 10**	**C2010.10**	**09 30 00**	**Tile Wall Finish**	100	2D+	Interiors
Level 4	**21-03 20 10 20**	**C2010.20**		**Wall Paneling**	100	2D+	Interiors
Level 4	**21-03 20 10 30**	**C2010.30**	**09 72 00**	**Wall Coverings**	100	2D+	Interiors
Level 4	**21-03 20 10 35**	**C2010.35**	**09 73 00**	**Wall Carpeting**	100	2D+	Interiors
Level 4	**21-03 20 10 50**	**C2010.50**	**09 75 00**	**Stone Facing**	100	2D+	Interiors
Level 4	**21-03 20 10 60**	**C2010.60**	**09 77 00**	**Special Wall Surfacing**	100	2D+	Interiors
Level 4	**21-03 20 10 70**	**C2010.70**	**09 90 00**	**Wall Painting and Coating**	100	2D+	Interiors
Level 4	**21-03 20 10 80**	**C2010.80**		**Acoustical Wall Treatment**	100	2D+	Interiors
Level 4	**21-03 20 10 90**	**C2010.90**		**Wall Finish Supplementary Components**	100	2D-	Interiors
Level 3	**21-03 20 20**	**C2020**		**Interior Fabrications**	**100**	**2D+**	Interiors
Level 3	**21-03 20 30**	**C2030**	**09 60 00**	**Flooring**	•	•	Architectural, Interiors
Level 4	**21-03 20 30 10**	**C2030.10**	**09 61 00**	**Flooring Treatment**	100	2D+	Interiors
Level 4	**21-03 20 30 20**	**C2030.20**	**09 30 00**	**Tile Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 30**	**C2030.30**	**09 62 00**	**Specialty Flooring**	100	2D+	Interiors

MINIMUM MODELING MATRIX

					DESIGN MODEL (CONSTRUCTION DOCUMENT)		
Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-03 20 30 40**	**C2030.40**	**09 63 00**	**Masonry Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 45**	**C2030.45**	**09 64 00**	**Wood Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 50**	**C2030.50**	**09 65 00**	**Resilient Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 60**	**C2030.60**	**09 66 00**	**Terrazzo Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 70**	**C2030.70**	**09 67 00**	**Fluid-Applied Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 75**	**C2030.75**	**09 68 00**	**Carpeting**	100	2D+	Interiors
Level 4	**21-03 20 30 80**	**C2030.80**		**Athletic Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 85**	**C2030.85**		**Entrance Flooring**	100	2D+	Interiors
Level 4	**21-03 20 30 90**	**C2030.90**		**Flooring Supplementary Components**	100	2D-	Interiors
Level 3	**21-03 20 40**	**C2040**		**Stair Finishes**	•	•	Architectural, Interiors
Level 4	**21-03 20 40 20**	**C2040.20**	**09 30 00**	**Tile Stair Finish**	100	2D+	Interiors
Level 4	**21-03 20 40 40**	**C2040.40**	**09 63 00**	**Masonry Stair Finish**	100	2D+	Interiors
Level 4	**21-03 20 40 45**	**C2040.45**	**09 64 00**	**Wood Stair Finish**	100	2D+	Interiors
Level 4	**21-03 20 40 50**	**C2040.50**	**09 65 00**	**Resilient Stair Finish**	100	2D+	Interiors
Level 4	**21-03 20 40 60**	**C2040.60**	**09 66 00**	**Terrazzo Stair Finish**	100	2D+	Interiors
Level 4	**21-03 20 40 75**	**C2040.75**	**09 68 00**	**Carpeted Stair Finish**	100	2D+	Interiors
Level 3	**21-03 20 50**	**C2050**	**09 50 00**	**Ceiling Finishes**	•	•	Architectural, Interiors
Level 4	**21-03 20 50 10**	**C2050.10**	**09 20 00**	**Plaster and Gypsum Board Finish**	200	2D+	Architectural, Interiors
Level 4	**21-03 20 50 20**	**C2050.20**		**Ceiling Paneling**	200	2D+	Architectural, Interiors
Level 4	**21-03 20 50 70**	**C2050.70**	**09 90 00**	**Ceiling Painting and Coating**	100	2D+	Architectural, Interiors
Level 4	**21-03 20 50 80**	**C2050.80**		**Acoustical Ceiling Treatment**	200	2D+	Architectural, Interiors
Level 4	**21-03 20 50 90**	**C2050.90**		**Ceiling Finish Supplementary Components**	100	2D-	Architectural, Interiors
Level 1	**21-04 00 00**	**D**		**SERVICES**	•	•	Architectural, Electrical, Fire Protection, Mechanical (HVAC), Plumbing
Level 2	**21-04 10**	**D10**	**14 00 00**	**CONVEYING**	•	•	Architectural, Specialty Consultants
Level 3	**21-04 10 10**	**D1010**		**Vertical Conveying Systems**	•	•	Architectural
Level 4	**21-04 10 10 10**	**D1010.10**	**14 20 00**	**Elevators**	300	3D+	Architectural
Level 4	**21-04 10 10 20**	**D1010.20**	**14 40 00**	**Lifts**	300	3D+	Architectural
Level 4	**21-04 10 10 30**	**D1010.30**	**14 31 00**	**Escalators**	300	3D+	Architectural
Level 4	**21-04 10 10 50**	**D1010.50**	**14 10 00**	**Dumbwaiters**	300	3D+	Architectural
Level 4	**21-04 10 10 60**	**D1010.60**	**14 33 00**	**Moving Ramps**	300	3D+	Architectural
Level 3	**21-04 10 30**	**D1030**		**Horizontal Conveying Systems**	•	•	Architectural
Level 4	**21-04 10 30 10**	**D1030.10**	**14 32 00**	**Moving Walks**	300	3D+	Architectural
Level 4	**21-04 10 30 30**	**D1030.30**	**14 70 00**	**Turntables**	300	3D+	Architectural

MINIMUM MODELING MATRIX

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-04 10 30 50**	**D1030.50**	**34 77 13**	**Passenger Loading Bridges**	300	3D+	Architectural
Level 4	**21-04 10 30 70**	**D1030.70**		**People Movers**	300	3D+	Architectural
Level 3	**21-04 10 50**	**D1050**		**Material Handling**	•	•	Specialty Consultants
Level 4	**21-04 10 50 10**	**D1050.10**	**41 22 13**	**Cranes**	300	3D+	Specialty Consultants
Level 4	**21-04 10 50 20**	**D1050.20**	**41 22 23**	**Hoists**	300	3D+	Specialty Consultants
Level 4	**21-04 10 50 30**	**D1050.30**	**41 22 33**	**Derricks**	300	3D+	Specialty Consultants
Level 4	**21-04 10 50 40**	**D1050.40**	**41 21 00**	**Conveyors**	300	3D+	Specialty Consultants
Level 4	**21-04 10 50 50**	**D1050.50**	**34 77 16**	**Baggage Handling Equipment**	300	3D+	Specialty Consultants
Level 4	**21-04 10 50 60**	**D1050.60**	**14 91 00**	**Chutes**	200	3D+	Specialty Consultants
Level 4	**21-04 10 50 70**	**D1050.70**	**14 92 00**	**Pneumatic Tube Systems**	300	3D+	Specialty Consultants
Level 3	**21-04 10 80**	**D1080**		**Operable Access Systems**	•	•	Specialty Consultants
Level 4	**21-04 10 80 10**	**D1080.10**	**14 81 00**	**Suspended Scaffolding**	200	3D+	Specialty Consultants
Level 4	**21-04 10 80 20**	**D1080.20**	**14 82 00**	**Rope Climbers**	200	2D+	Specialty Consultants
Level 4	**21-04 10 80 30**	**D1080.30**	**14 83 00**	**Elevating Platforms**	200	3D+	Specialty Consultants
Level 4	**21-04 10 80 40**	**D1080.40**	**14 84 00**	**Powered Scaffolding**	200	3D+	Specialty Consultants
Level 4	**21-04 10 80 50**	**D1080.50**		**Building Envelope Access**	200	2D-	Specialty Consultants
Level 2	**21-04 20**	**D20**	**22 00 00**	**PLUMBING**	•	•	Plumbing
Level 3	**21-04 20 10**	**D2010**	**22 11 00**	**Domestic Water Distribution**	•	•	Plumbing
Level 4	**21-04 20 10 10**	**D2010.10**	**22 12 00**	**Facility Potable-Water Storage Tanks**	200	3D+	Plumbing
Level 4	**21-04 20 10 20**	**D2010.20**		**Domestic Water Equipment**	200	3D+	Plumbing
Level 4	**21-04 20 10 40**	**D2010.40**	**22 11 16**	**Domestic Water Piping**	200	3D+	Plumbing
Level 4	**21-04 20 10 60**	**D2010.60**	**22 40 00**	**Plumbing Fixtures**	200	3D+	Plumbing
Level 4	**21-04 20 10 90**	**D2010.90**		**Domestic Water Distribution Supplementary Components**	100	2D+	Plumbing
Level 3	**21-04 20 20**	**D2020**	**22 13 00**	**Sanitary Drainage**	•	•	Plumbing
Level 4	**21-04 20 20 10**	**D2020.10**		**Sanitary Sewerage Equipment**	200	3D+	Plumbing
Level 4	**21-04 20 20 30**	**D2020.30**		**Sanitary Sewerage Piping**	200	3D+	Plumbing
Level 4	**21-04 20 20 90**	**D2020.90**		**Sanitary Drainage Supplementary Components**	100	2D+	Plumbing
Level 3	**21-04 20 30**	**D2030**	**22 14 00**	**Building Support Plumbing Systems**	•	•	Plumbing
Level 4	**21-04 20 30 10**	**D2030.10**		**Stormwater Drainage Equipment**	200	3D+	Plumbing
Level 4	**21-04 20 30 20**	**D2030.20**	**22 14 13**	**Stormwater Drainage Piping**	200	3D+	Plumbing
Level 4	**21-04 20 30 30**	**D2030.30**	**22 14 26**	**Facility Stormwater Drains**	200	3D+	Plumbing
Level 4	**21-04 20 30 60**	**D2030.60**		**Gray Water Systems**	200	3D+	Plumbing
Level 4	**21-04 20 30 90**	**D2030.90**		**Building Support Plumbing System Supplementary Components**	100	2D+	Plumbing

MINIMUM MODELING MATRIX

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 3	**21-04 20 50**	**D2050**	**22 15 00**	**General Service Compressed-Air**	**200**	**3D+**	Plumbing
Level 3	**21-04 20 60**	**D2060**		**Process Support Plumbing Systems**	•	•	Plumbing
Level 4	**21-04 20 60 10**	**D2060.10**	**22 61 00**	**Compressed-Air Systems**	200	3D+	Plumbing
Level 4	**21-04 20 60 20**	**D2060.20**	**22 62 00**	**Vacuum Systems**	200	3D+	Plumbing
Level 4	**21-04 20 60 30**	**D2060.30**	**22 63 00**	**Gas Systems**	200	3D+	Plumbing
Level 4	**21-04 20 60 40**	**D2060.40**	**22 66 00**	**Chemical-Waste Systems**	200	3D+	Plumbing
Level 4	**21-04 20 60 50**	**D2060.50**	**22 67 00**	**Processed Water Systems**	200	3D+	Plumbing
Level 4	**21-04 20 60 90**	**D2060.90**		**Process Support Plumbing System Supplementary Components**	100	2D+	Plumbing
Level 2	**21-04 30**	**D30**	**23 00 00**	**HVAC**	•	•	Mechanical (HVAC)
Level 3	**21-04 30 10**	**D3010**	**23 10 00**	**Facility Fuel Systems**	•	•	Mechanical (HVAC)
Level 4	**21-04 30 10 10**	**D3010.10**	**23 11 00**	**Fuel Piping**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 10 30**	**D3010.30**	**23 12 00**	**Fuel Pumps**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 10 50**	**D3010.50**	**23 13 00**	**Fuel Storage Tanks**	200	3D+	Mechanical (HVAC)
Level 3	**21-04 30 20**	**D3020**		**Heating Systems**	•	•	Mechanical (HVAC)
Level 4	**21-04 30 20 10**	**D3020.10**		**Heat Generation**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 20 30**	**D3020.30**	**23 71 13**	**Thermal Heat Storage**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 20 70**	**D3020.70**	**23 80 00**	**Decentralized Heating Equipment**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 20 90**	**D3020.90**		**Heating System Supplementary Components**	100	2D+	Mechanical (HVAC)
Level 3	**21-04 30 30**	**D3030**		**Cooling Systems**	•	•	Mechanical (HVAC)
Level 4	**21-04 30 30 10**	**D3030.10**	**23 60 00**	**Central Cooling**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 30 30**	**D3030.30**	**23 76 00**	**Evaporative Air-Cooling**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 30 50**	**D3030.50**	**23 71 00**	**Thermal Cooling Storage**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 30 70**	**D3030.70**	**23 80 00**	**Decentralized Cooling**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 30 90**	**D3030.90**		**Cooling System Supplementary Components**	100	2D+	Mechanical (HVAC)
Level 3	**21-04 30 50**	**D3050**		**Facility HVAC Distribution Systems**	•	•	Mechanical (HVAC)
Level 4	**21-04 30 50 10**	**D3050.10**		**Facility Hydronic Distribution**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 50 30**	**D3050.30**		**Facility Steam Distribution**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 50 50**	**D3050.50**		**HVAC Air Distribution**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 50 90**	**D3050.90**		**Facility Distribution Systems Supplementary Components**	100	2D+	Mechanical (HVAC)
Level 3	**21-04 30 60**	**D3060**		**Ventilation**	•	•	Mechanical (HVAC)
Level 4	**21-04 30 60 10**	**D3060.10**		**Supply Air**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 60 20**	**D3060.20**		**Return Air**	200	3D+	Mechanical (HVAC)
Level 4	**21-04 30 60 30**	**D3060.30**		**Exhaust Air**	200	3D+	Mechanical (HVAC)

MINIMUM MODELING MATRIX

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	21-04 30 60 40	D3060.40		Outside Air	200	3D+	Mechanical (HVAC)
Level 4	21-04 30 60 60	D3060.60	23 72 00	Air-to-Air Energy Recovery	200	3D+	Mechanical (HVAC)
Level 4	21-04 30 60 70	D3060.70	23 40 00	HVAC Air Cleaning	200	2D+	Mechanical (HVAC)
Level 4	21-04 30 60 90	D3060.90		Ventilation Supplementary Components	100	2D+	Mechanical (HVAC)
Level 3	21-04 30 70	D3070		Special Purpose HVAC Systems	•	•	Mechanical (HVAC)
Level 4	21-04 30 70 10	D3070.10	23 83 00	Snow Melting	100	2D+	Mechanical (HVAC)
Level 2	21-04 40	D40	21 00 00	FIRE PROTECTION	•	•	Architectural, Fire Protection
Level 3	21-04 40 10	D4010	10 44 00	Fire Suppression	•	•	Fire Protection
Level 4	21-04 40 10 10	D4010.10	21 10 00	Water-Based Fire-Suppression	200	3D+	Fire Protection
Level 4	21-04 40 10 50	D4010.50	21 20 00	Fire-Extinguishing	200	3D+	Fire Protection
Level 4	21-04 40 10 90	D4010.90		Fire Suppression Supplementary Components	100	2D+	Fire Protection
Level 3	21-04 40 30	D4030	26 00 00	Fire Protection Specialties	•	•	Architectural
Level 4	21-04 40 30 10	D4030.10	10 44 13	Fire Protection Cabinets	200	3D+	Architectural
Level 4	21-04 40 30 30	D4030.30	10 44 16	Fire Extinguishers	200	3D+	Architectural
Level 4	21-04 40 30 50	D4030.50	10 44 33	Breathing Air Replenishment Systems	200	3D+	Architectural
Level 4	21-04 40 30 70	D4030.70	10 44 43	Fire Extinguisher Accessories	200	3D+	Architectural
Level 2	21-04 50	D50		ELECTRICAL	•	•	Electrical
Level 3	21-04 50 10	D5010		Facility Power Generation	•	•	Electrical
Level 4	21-04 50 10 10	D5010.10	26 32 00	Packaged Generator Assemblies	200	3D+	Electrical, Specialty Consultants
Level 4	21-04 50 10 20	D5010.20	26 33 00	Battery Equipment	200	3D+	Electrical, Mechanical (HVAC), Specialty Consultants
Level 4	21-04 50 10 30	D5010.30	26 31 00	Photovoltaic Collectors	200	3D+	Architectural, Electrical, Specialty Consultants
Level 4	21-04 50 10 40	D5010.40	48 18 00	Fuel Cells	200	3D+	Electrical, Plumbing, Specialty Consultants
Level 4	21-04 50 10 60	D5010.60	26 35 00	Power Filtering and Conditioning	100	2D+	Electrical
Level 4	21-04 50 10 70	D5010.70	26 36 00	Transfer Switches	100	2D+	Electrical
Level 4	21-04 50 10 90	D5010.90		Facility Power Generation Supplementary Components	100	3D+	Electrical, Specialty Consultants
Level 3	21-04 50 20	D5020		Electrical Service and Distribution	•	•	Electrical
Level 4	21-04 50 20 10	D5020.10	26 21 00	Electrical Service	200	3D+	Electrical
Level 4	21-04 50 20 30	D5020.30	26 20 00	Power Distribution	200	3D+	Electrical
Level 4	21-04 50 20 70	D5020.70	26 05 26	Facility Grounding	200	3D+	Electrical
Level 4	21-04 50 20 90	D5020.90		Electrical Service and Distribution Supplementary	200	2D+	Electrical

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
				Components			
Level 3	**21-04 50 30**	**D5030**		**General Purpose Electrical Power**	•	•	Electrical
Level 4	**21-04 50 30 10**	**D5030.10**		**Branch Wiring System**	200	2D+	Electrical
Level 4	**21-04 50 30 50**	**D5030.50**	**26 27 26**	**Wiring Devices**	200	2D+	Electrical
Level 4	**21-04 50 30 90**	**D5030.90**		**General Purpose Electrical Power Supplementary Components**	200	2D+	Electrical
Level 3	**21-04 50 40**	**D5040**	**26 50 00**	**Lighting**	•	•	Electrical
Level 4	**21-04 50 40 10**	**D5040.10**	**26 09 23**	**Lighting Control**	200	3D+	Electrical
Level 4	**21-04 50 40 20**	**D5040.20**		**Branch Wiring for Lighting**	200	2D+	Electrical
Level 4	**21-04 50 40 50**	**D5040.50**	**26 50 00**	**Lighting Fixtures**	300	3D+	Electrical
Level 4	**21-04 50 40 90**	**D5040.90**		**Lighting Supplementary Components**	200	3D+	Electrical
Level 3	**21-04 50 80**	**D5080**		**Miscellaneous Electrical Systems**	•	•	Electrical
Level 4	**21-04 50 80 10**	**D5080.10**	**26 41 00**	**Lightning Protection**	200	2D+	Electrical
Level 4	**21-04 50 80 40**	**D5080.40**	**26 42 00**	**Cathodic Protection**	200	3D+	Electrical
Level 4	**21-04 50 80 70**	**D5080.70**	**26 43 00**	**Transient Voltage Suppression**	200	3D+	Electrical
Level 4	**21-04 50 80 90**	**D5080.90**		**Miscellaneous Electrical Systems Supplementary Components**	100	2D+	Electrical
Level 2	**21-04 60**	**D60**	**27 00 00**	**COMMUNICATIONS**	•	•	Electrical
Level 3	**21-04 60 10**	**D6010**	**27 20 00**	**Data Communications**	•	•	Electrical
Level 4	**21-04 60 10 10**	**D6010.10**		**Data Communications Network and Equipment**	200	3D+	Electrical, Specialty Consultants
Level 4	**21-04 60 10 20**	**D6010.20**	**27 22 00**	**Data Communications Hardware**	200	3D+	Electrical, Specialty Consultants
Level 4	**21-04 60 10 30**	**D6010.30**		**Data Communications Peripheral Data Equipment**	200	3D+	Electrical, Specialty Consultants
Level 4	**21-04 60 10 50**	**D6010.50**	**27 25 00**	**Data Communications Software**	100	2D-	Electrical, Specialty Consultants
Level 4	**21-04 60 10 60**	**D6010.60**	**27 26 00**	**Data Communication Program and Integration Services**	100	2D-	Electrical, Specialty Consultants
Level 3	**21-04 60 20**	**D6020**	**27 30 00**	**Voice Communications**	•	•	Electrical
Level 4	**21-04 60 20 10**	**D6020.10**	**27 31 00**	**Voice Communications Switching and Routing Equipment**	200	3D+	Electrical, Specialty Consultants
Level 4	**21-04 60 20 20**	**D6020.20**		**Voice Communications Terminal Equipment**	200	3D+	Electrical, Specialty Consultants
Level 4	**21-04 60 20 30**	**D6020.30**	**27 33 00**	**Voice Communications Messaging**	100	2D-	Electrical, Specialty Consultants
Level 4	**21-04 60 20 40**	**D6020.40**	**27 34 00**	**Call Accounting**	100	2D-	Specialty Consultants
Level 4	**21-04 60 20 50**	**D6020.50**	**27 35 00**	**Call Management**	100	2D-	Specialty Consultants
Level 3	**21-04 60 30**	**D6030**	**27 40 00**	**Audio-Video Communication**	•	•	Electrical
Level 4	**21-04 60 30 10**	**D6030.10**	**27 41 00**	**Audio-Video Systems**	200	3D+	Electrical, Specialty Consultants

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-04 60 30 50**	**D6030.50**	**27 42 00**	**Electronic Digital Systems**	100	2D-	Electrical, Specialty Consultants
Level 3	**21-04 60 60**	**D6060**	**27 50 00**	**Distributed Communications and Monitoring**	•	•	Electrical
Level 4	**21-04 60 60 10**	**D6060.10**		**Distributed Audio-Video**	200	2D+	Electrical, Specialty Consultants
Level 4	**21-04 60 60 30**	**D6060.30**	**27 52 00**	**Healthcare Communications and Monitoring**	200	2D+	Electrical, Specialty Consultants
Level 4	**21-04 60 60 50**	**D6060.50**	**27 53 00**	**Distributed Systems**	200	2D+	Specialty Consultants
Level 3	**21-04 60 90**	**D6090**		**Communications Supplementary Components**	•	•	Electrical, Specialty Consultants
Level 4	**21-04 60 90 10**	**D6090.10**		**Supplementary Components**	100	2D-	Specialty Consultants
Level 2	**21-04 70**	**D70**	**28 00 00**	**ELECTRONIC SAFETY AND SECURITY**	•	•	Electrical
Level 3	**21-04 70 10**	**D7010**		**Access Control and Intrusion Detection**	•	•	Electrical
Level 4	**21-04 70 10 10**	**D7010.10**		**Access Control**	200	3D+	Electrical
Level 4	**21-04 70 10 50**	**D7010.50**		**Intrusion Detection**	200	3D+	Electrical
Level 3	**21-04 70 30**	**D7030**		**Electronic Surveillance**	•	•	Electrical
Level 4	**21-04 70 30 10**	**D7030.10**		**Video Surveillance**	200	3D+	Electrical
Level 4	**21-04 70 30 50**	**D7030.50**		**Electronic Personal Protection**	100	2D+	Electrical
Level 3	**21-04 70 50**	**D7050**		**Detection and Alarm**	•	•	Electrical
Level 4	**21-04 70 50 10**	**D7050.10**		**Fire Detection and Alarm**	200	3D+	Electrical
Level 4	**21-04 70 50 20**	**D7050.20**		**Radiation Detection and Alarm**	200	3D+	Electrical
Level 4	**21-04 70 50 30**	**D7050.30**		**Fuel-Gas Detection and Alarm**	200	3D+	Electrical
Level 4	**21-04 70 50 40**	**D7050.40**		**Fuel-Oil Detection and Alarm**	200	3D+	Electrical
Level 4	**21-04 70 50 50**	**D7050.50**		**Refrigeration Detection and Alarm**	200	3D+	Electrical
Level 4	**21-04 70 50 60**	**D7050.60**		**Water Intrusion Detection and Alarm**	200	3D+	Electrical
Level 3	**21-04 70 70**	**D7070**		**Electronic Monitoring and Control**	•	•	Electrical
Level 4	**21-04 70 70 10**	**D7070.10**		**Electronic Detection Monitoring and Control**	200	3D+	Electrical
Level 3	**21-04 70 90**	**D7090**		**Electronic Safety and Security Supplementary Components**	•	•	Electrical
Level 4	**21-04 70 90 10**	**D7090.10**		**Supplementary Components**	100	2D-	Electrical
Level 2	**21-04 80**	**D80**		**INTEGRATED AUTOMATION**	•	•	Electrical
Level 3	**21-04 80 10**	**D8010**		**Integrated Automation Facility Controls**	•	•	Electrical
Level 4	**21-04 80 10 10**	**D8010.10**		**Integrated Automation Control of Equipment**	200	2D+	Electrical
Level 4	**21-04 80 10 20**	**D8010.20**		**Integrated Automation Control of Conveying Equipment**	200	2D+	Electrical
Level 4	**21-04 80 10 30**	**D8010.30**		**Integrated Automation Control of Fire-Suppression Systems**	200	2D+	Electrical

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Level 4	**21-04 80 10 40**	**D8010.40**		**Integrated Automation Control of HVAC Systems**	200	2D+	Electrical
Level 4	**21-04 80 10 50**	**D8010.50**		**Integrated Automation Control of Plumbing Systems**	200	2D+	Electrical
Level 4	**21-04 80 10 60**	**D8010.60**		**Integrated Automation Control of Electrical Systems**	200	2D+	Electrical
Level 4	**21-04 80 10 70**	**D8010.70**		**Integrated Automation Control of Communication Systems**	200	2D+	Electrical
Level 4	**21-04 80 10 80**	**D8010.80**		**Integrated Automation Control of Electronic Safety and Security Systems**	200	2D+	Electrical
Level 4	**21-04 80 10 90**	**D8010.90**		**Integrated Automation Supplementary Components**	100	2D-	Electrical
Level 1	**21-05 00 00**	**E**		**EQUIPMENT & FURNISHINGS**	•	•	Architectural, Interiors
Level 2	**21-05 10 00**	**E10**		**EQUIPMENT**	•	•	Architectural, Specialty Consultants
Level 3	**21-05 10 10**	**E1010**	**11 10 00**	**Vehicle and Pedestrian Equipment**	•	•	Architectural, Specialty Consultants
Level 4	**21-05 10 10 10**	**E1010.10**	**11 11 00**	**Vehicle Servicing Equipment**	200	3D+	Architectural, Specialty Consultants
Level 4	**21-05 10 10 30**	**E1010.30**	**11 12 00**	**Interior Parking Control Equipment**	200	3D+	Architectural, Specialty Consultants
Level 4	**21-05 10 10 50**	**E1010.50**	**11 13 00**	**Loading Dock Equipment**	300	3D+	Architectural, Electrical, Specialty Consultants
Level 4	**21-05 10 10 70**	**E1010.70**	**11 14 00**	**Interior Pedestrian Control Equipment**	200	3D+	Architectural, Electrical, Specialty Consultants
Level 3	**21-05 10 30**	**E1030**	**11 20 00**	**Commercial Equipment**	•	•	Architectural, Specialty Consultants
Level 4	**21-05 10 30 10**	**E1030.10**	**11 21 00**	**Mercantile and Service Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 20**	**E1030.20**	**11 16 00**	**Vault Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 25**	**E1030.25**	**11 17 00**	**Teller and Service Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 30**	**E1030.30**	**11 22 00**	**Refrigerated Display Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 35**	**E1030.35**		**Commercial Laundry and Dry Cleaning Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 40**	**E1030.40**	**11 24 00**	**Maintenance Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 50**	**E1030.50**	**11 25 00**	**Hospitality Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 55**	**E1030.55**	**11 26 00**	**Unit Kitchens**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 60**	**E1030.60**	**11 27 00**	**Photographic Processing Equipment**	300	3D+	Specialty Consultants
Level 4	**21-05 10 30 70**	**E1030.70**	**11 29 00**	**Postal, Packaging, and Shipping Equipment**	300	3D+	Specialty Consultants

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	21-05 10 30 75	E1030.75	11 28 00	Office Equipment	300	3D+	Specialty Consultants
Level 4	21-05 10 30 80	E1030.80	11 40 00	Foodservice Equipment	300	3D+	Specialty Consultants
Level 3	21-05 10 40	E1040	11 50 00	Institutional Equipment	•	•	Architectural, Specialty Consultants
Level 4	21-05 10 40 10	E1040.10	11 50 00	Educational and Scientific Equipment	300	3D+	Specialty Consultants
Level 4	21-05 10 40 20	E1040.20	11 70 00	Healthcare Equipment	300	3D+	Specialty Consultants
Level 4	21-05 10 40 40	E1040.40	11 91 00	Religious Equipment	300	3D+	Specialty Consultants
Level 4	21-05 10 40 60	E1040.60	11 18 00	Security Equipment	300	3D+	Electrical, Specialty Consultants
Level 4	21-05 10 40 70	E1040.70	11 19 00	Detention Equipment	300	3D+	Specialty Consultants
Level 3	21-05 10 60	E1060	11 30 00	Residential Equipment	•	•	Architectural
Level 4	21-05 10 60 10	E1060.10	11 31 00	Residential Appliances	300	3D+	Architectural
Level 4	21-05 10 60 50	E1060.50	11 33 00	Retractable Stairs	200	3D+	Architectural
Level 4	21-05 10 60 70	E1060.70	11 34 00	Residential Ceiling Fans	200	3D+	Architectural
Level 3	21-05 10 70	E1070		Entertainment and Recreational Equipment	•	•	Architectural, Specialty Consultants
Level 4	21-05 10 70 10	E1070.10	11 61 00	Theater and Stage Equipment	300	3D+	Specialty Consultants
Level 4	21-05 10 70 20	E1070.20	11 62 00	Musical Equipment	200	3D+	Specialty Consultants
Level 4	21-05 10 70 50	E1070.50	11 66 00	Athletic Equipment	200	3D+	Specialty Consultants
Level 4	21-05 10 70 60	E1070.60	11 67 00	Recreational Equipment	300	3D+	Specialty Consultants
Level 3	21-05 10 90	E1090	11 90 00	Other Equipment	•	•	Architectural, Specialty Consultants
Level 4	21-05 10 90 10	E1090.10	11 82 00	Solid Waste Handling Equipment	200	3D+	Specialty Consultants
Level 4	21-05 10 90 30	E1090.30	11 92 00	Agricultural Equipment	200	3D+	Specialty Consultants
Level 4	21-05 10 90 40	E1090.40	11 93 00	Horticultural Equipment	200	3D+	Specialty Consultants
Level 4	21-05 10 90 60	E1090.60		Decontamination Equipment	200	3D+	Specialty Consultants
Level 2	21-05 20	E20	12 00 00	FURNISHINGS	•	•	Interiors
Level 3	21-05 20 10	E2010		Fixed Furnishings	•	•	Interiors
Level 4	21-05 20 10 10	E2010.10	12 10 00	Fixed Art	100	2D+	Interiors
Level 4	21-05 20 10 20	E2010.20	12 20 00	Window Treatments	200	2D+	Interiors
Level 4	21-05 20 10 30	E2010.30	12 30 00	Casework	300	3D+	Interiors
Level 4	21-05 20 10 70	E2010.70	12 60 00	Fixed Multiple Seating	200	3D+	Interiors
Level 4	21-05 20 10 90	E2010.90	12 90 00	Other Fixed Furnishings	200	3D+	Interiors
Level 3	21-05 20 50	E2050		Movable Furnishings	•	•	Interiors
Level 4	21-05 20 50 10	E2050.10	12 10 00	Movable Art	100	2D+	Interiors
Level 4	21-05 20 50 30	E2050.30	12 50 00	Furniture	300	2D+	Interiors
Level 4	21-05 20 50 40	E2050.40	12 40 00	Accessories	100	2D+	Interiors
Level 4	21-05 20 50 60	E2050.60	12 60 00	Movable Multiple Seating	200	2D+	Interiors

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Level 4	**21-05 20 50 90**	**E2050.90**	**12 90 00**	**Other Movable Furnishings**	100	2D+	Interiors
Level 1	**21-06 00 00**	**F**		**SPECIAL CONSTRUCTION AND DEMOLITION**	•	•	Architectural, Civil, Mechanical (HVAC), Specialty Consultants
Level 2	**21-06 10**	**F10**		**SPECIAL CONSTRUCTION**	•	•	Architectural, Mechanical (HVAC), Structural
Level 3	**21-06 10 10**	**F1010**		**Integrated Construction**	•	•	Architectural, Electrical, Fire Protection, Interiors, Mechanical (HVAC), Plumbing, Structural
Level 4	**21-06 10 10 10**	**F1010.10**	**13 42 00**	**Building Modules**	200	3D+	Architectural, Electrical, Mechanical (HVAC), Plumbing, Structural
Level 4	**21-06 10 10 50**	**F1010.50**	**13 20 00**	**Manufactured/Fabricated Rooms**	200	3D+	Architectural, Electrical, Mechanical (HVAC), Plumbing
Level 4	**21-06 10 10 70**	**F1010.70**	**13 44 00**	**Modular Mezzanines**	200	3D+	Architectural, Structural
Level 3	**21-06 10 20**	**F1020**	**13 30 00**	**Special Structures**	•	•	Specialty Consultants
Level 4	**21-06 10 20 10**	**F1020.10**	**13 31 00**	**Fabric Structures**	200	3D+	Specialty Consultants
Level 4	**21-06 10 20 20**	**F1020.20**	**13 32 00**	**Space Frames**	200	3D+	Specialty Consultants
Level 4	**21-06 10 20 30**	**F1020.30**	**13 33 00**	**Geodesic Structures**	200	3D+	Specialty Consultants
Level 4	**21-06 10 20 40**	**F1020.40**	**13 34 00**	**Manufacturer-Engineered Structures**	200	3D+	Specialty Consultants
Level 4	**21-06 10 20 60**	**F1020.60**	**10 73 16**	**Manufactured Canopies**	200	3D+	Specialty Consultants
Level 4	**21-06 10 20 65**	**F1020.65**	**13 35 00**	**Rammed Earth Construction**	200	3D+	Specialty Consultants
Level 4	**21-06 10 20 70**	**F1020.70**	**13 36 00**	**Towers**	200	3D+	Specialty Consultants
Level 3	**21-06 10 30**	**F1030**		**Special Function Construction**	•	•	Architectural, Specialty Consultants
Level 4	**21-06 10 30 10**	**F1030.10**	**13 48 00**	**Sound and Vibration Control**	200	3D+	Architectural, Mechanical (HVAC), Plumbing, Specialty Consultants
Level 4	**21-06 10 30 30**	**F1030.30**	**13 48 00**	**Seismic Control**	200	3D+	Architectural, Specialty Consultants, Structural
Level 4	**21-06 10 30 50**	**F1030.50**	**13 49 00**	**Radiation Protection**	200	3D+	Architectural, Specialty Consultants
Level 3	**21-06 10 50**	**F1050**		**Special Facility Components**	•	•	Architectural, Specialty Consultants
Level 4	**21-06 10 50 10**	**F1050.10**		**Pools**	300	3D+	Architectural, Specialty Consultants
Level 4	**21-06 10 50 20**	**F1050.20**	**13 12 23**	**Interior Fountains**	300	3D+	Architectural, Interiors, Specialty Consultants

MINIMUM MODELING MATRIX

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-06 10 50 30**	**F1050.30**		**Interior Water Features**	200	3D+	Architectural, Interiors, Specialty Consultants
Level 4	**21-06 10 50 40**	**F1050.40**	**13 13 00**	**Aquariums**	300	3D+	Specialty Consultants
Level 4	**21-06 10 50 50**	**F1050.50**	**13 14 00**	**Amusement Park Structures and Equipment**	300	3D+	Specialty Consultants
Level 4	**21-06 10 50 60**	**F1050.60**	**13 18 00**	**Ice Rinks**	300	3D+	Specialty Consultants
Level 4	**21-06 10 50 70**	**F1050.70**	**13 19 00**	**Animal Containment**	300	3D+	Architectural, Specialty Consultants
Level 3	**21-06 10 60**	**F1060**	**13 28 00**	**Athletic and Recreational Special Construction**	•	•	Architectural, Specialty Consultants
Level 4	**21-06 10 60 10**	**F1060.10**	**13 28 13**	**Indoor Soccer Boards**	200	3D+	Specialty Consultants
Level 4	**21-06 10 60 20**	**F1060.20**	**13 28 16**	**Safety Netting**	200	2D+	Specialty Consultants
Level 4	**21-06 10 60 30**	**F1060.30**	**13 28 19**	**Arena Football Boards**	200	3D+	Specialty Consultants
Level 4	**21-06 10 60 40**	**F1060.40**	**13 28 26**	**Floor Sockets**	300	2D+	Specialty Consultants
Level 4	**21-06 10 60 50**	**F1060.50**	**13 28 33**	**Athletic and Recreational Court Walls**	200	2D+	Specialty Consultants
Level 4	**21-06 10 60 60**	**F1060.60**	**13 28 66**	**Demountable Athletic Surfaces**	200	2D+	Specialty Consultants
Level 3	**21-06 10 80**	**F1080**	**13 50 00**	**Special Instrumentation**	•	•	Electrical, Specialty Consultants
Level 4	**21-06 10 80 10**	**F1080.10**	**13 51 00**	**Stress Instrumentation**	200	2D+	Specialty Consultants
Level 4	**21-06 10 80 20**	**F1080.20**	**13 51 00**	**Seismic Instrumentation**	200	2D+	Specialty Consultants
Level 4	**21-06 10 80 40**	**F1080.40**	**13 51 00**	**Meteorological Instrumentation**	200	3D+	Specialty Consultants
Level 4	**21-06 10 80 60**	**F1080.60**		**Earth Movement Monitoring**	100	2D+	Specialty Consultants
Level 2	**21-06 20 00**	**F20**		**FACILITY REMEDIATION**	•	•	Specialty Consultants
Level 3	**21-06 20 10**	**F2010**		**Hazardous Materials and Remediation**	•	•	Specialty Consultants
Level 4	**21-06 20 10 10**	**F2010.10**		**Transportation and Disposal of Hazardous Materials**	100	2D-	Specialty Consultants
Level 4	**21-06 20 10 20**	**F2010.20**	**02 82 00**	**Asbestos Remediation**	100	2D-	Specialty Consultants
Level 4	**21-06 20 10 30**	**F2010.30**	**02 83 00**	**Lead Remediation**	100	2D-	Specialty Consultants
Level 4	**21-06 20 10 40**	**F2010.40**	**02 84 00**	**Polychlorinate Biphenyl Remediation**	100	2D-	Specialty Consultants
Level 4	**21-06 20 10 50**	**F2010.50**	**02 85 00**	**Mold Remediation**	100	2D-	Specialty Consultants
Level 2	**21-06 30 00**	**F30**		**DEMOLITION**	•	•	Architectural, Structural
Level 3	**21-06 30 10**	**F3010**	**02 41 16**	**Structure Demolition**	•	•	Architectural, Structural
Level 4	**21-06 30 10 10**	**F3010.10**	**02 41 16.13**	**Building Elements Demolition**	100	2D-	Architectural
Level 4	**21-06 30 10 30**	**F3010.30**	**02 41 16.23**	**Tower Demolition**	100	2D-	Architectural
Level 4	**21-06 30 10 50**	**F3010.50**	**02 41 16.33**	**Bridge Demolition**	100	2D-	Architectural, Civil
Level 4	**21-06 30 10 70**	**F3010.70**	**02 41 16.43**	**Dam Demolition**	100	2D-	Architectural, Civil

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Level 3	**21-06 30 30**	**F3030**	**02 41 19**	**Selective Demolition**	•	•	Architectural, Civil, Electrical, Equipment, Fire Protection, Interiors, Mechanical (HVAC), Plumbing
Level 4	**21-06 30 30 10**	**F3030.10**	**02 41 19.13**	**Selective Bldg Demo**	100	2D-	Architectural, Civil, Electrical, Equipment, Fire Protection, Interiors, Mechanical (HVAC), Plumbing
Level 4	**21-06 30 30 30**	**F3030.30**	**02 41 19.16**	**Selective Interior Demolition**	100	2D-	Architectural, Electrical, Equipment, Fire Protection, Interiors, Mechanical (HVAC), Plumbing
Level 4	**21-06 30 30 50**	**F3030.50**	**02 41 19.33**	**Selective Bridge Demolition**	100	2D-	Architectural, Civil, Specialty Consultants
Level 4	**21-06 30 30 70**	**F3030.70**	**02 41 91**	**Selective Historic Demolition**	100	2D-	Architectural, Civil, Electrical, Equipment, Fire Protection, Interiors, Mechanical (HVAC), Plumbing, Specialty Consultants
Level 3	**21-06 30 50**	**F3050**	**02 43 00**	**Structure Moving**	•	•	Specialty Consultants
Level 4	**21-06 30 50 10**	**F3050.10**	**02 43 13**	**Structure Relocation**	100	2D-	Specialty Consultants
Level 4	**21-06 30 50 30**	**F3050.30**	**02 43 16**	**Structure Raising**	100	2D-	Specialty Consultants
Level 1	**21-07 00 00**	**G**		**SITEWORK**	•	•	Civil, Plumbing
Level 2	**21-07 10 00**	**G10**		**SITE PREPARATIONS**	•	•	Civil
Level 3	**21-07 10 10**	**G1010**	**31 10 00**	**Site Clearing**	•	•	Civil
Level 4	**21-07 10 10 10**	**G1010.10**	**31 11 00**	**Clearing and Grubbing**	100	2D-	Civil
Level 4	**21-07 10 10 30**	**G1010.30**	**31 13 00**	**Tree and Shrub Removal and Trimming**	100	2D-	Civil
Level 4	**21-07 10 10 50**	**G1010.50**	**31 14 00**	**Earth Stripping and Stockpiling**	100	2D-	Civil
Level 3	**21-07 10 20**	**G1020**		**Site Elements Demolition**	•	•	Civil
Level 4	**21-07 10 20 10**	**G1020.10**		**Utility Demolition**	200	3D+	Civil
Level 4	**21-07 10 20 30**	**G1020.30**		**Infrastructure Demolition**	100	2D-	Architectural, Civil
Level 4	**21-07 10 20 50**	**G1020.50**	**02 41 13**	**Selective Site Demolition**	100	2D-	Architectural, Civil
Level 3	**21-07 10 30**	**G1030**		**Site Element Relocations**	•	•	Civil
Level 4	**21-07 10 30 10**	**G1030.10**		**Utility Relocation**	200	3D+	Civil
Level 3	**21-07 10 50**	**G1050**	**02 50 00**	**Site Remediation**	•	•	Specialty Consultants
Level 4	**21-07 10 50 10**	**G1050.10**	**02 51 00**	**Physical Decontamination**	100	2D-	Specialty Consultants
Level 4	**21-07 10 50 15**	**G1050.15**	**02 52 00**	**Chemical Decontamination**	100	2D-	Specialty Consultants
Level 4	**21-07 10 50 20**	**G1050.20**	**02 53 00**	**Thermal Decontamination**	100	2D-	Specialty Consultants

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Level 4	21-07 10 50 25	G1050.25	02 54 00	Biological Decontamination	100	2D-	Specialty Consultants
Level 4	21-07 10 50 30	G1050.30	02 55 00	Remediation Soil Stabilization	100	2D-	Specialty Consultants
Level 4	21-07 10 50 40	G1050.40	02 56 00	Site Containment	100	2D-	Specialty Consultants
Level 4	21-07 10 50 45	G1050.45	02 57 00	Sinkhole Remediation	100	2D-	Specialty Consultants
Level 4	21-07 10 50 50	G1050.50	02 86 00	Hazardous Waste Drum Handling	100	2D-	Specialty Consultants
Level 4	21-07 10 50 60	G1050.60	02 60 00	Contaminated Site Material Removal	100	2D-	Specialty Consultants
Level 4	21-07 10 50 80	G1050.80	02 70 00	Water Remediation	100	2D-	Specialty Consultants
Level 3	21-07 10 70	G1070	31 20 00	Site Earthwork	•	•	Civil
Level 4	21-07 10 70 10	G1070.10	31 22 00	Grading	100	2D-	Civil
Level 4	21-07 10 70 20	G1070.20	31 23 00	Excavation and Fill	100	2D-	Civil
Level 4	21-07 10 70 30	G1070.30	31 24 00	Embankments	100	2D-	Civil
Level 4	21-07 10 70 35	G1070.35	31 25 00	Erosion and Sedimentation Controls	100	2D-	Civil
Level 4	21-07 10 70 40	G1070.40	31 32 00	Soil Stabilization	100	2D-	Civil
Level 4	21-07 10 70 45	G1070.45	31 33 00	Rock Stabilization	100	2D-	Civil
Level 4	21-07 10 70 50	G1070.50	31 34 00	Soil Reinforcement	100	2D-	Civil
Level 4	21-07 10 70 55	G1070.55	31 35 00	Slope Protection	100	2D-	Civil
Level 4	21-07 10 70 60	G1070.60	31 36 00	Gabions	100	2D-	Civil
Level 4	21-07 10 70 65	G1070.65	31 37 00	Riprap	100	2D-	Civil
Level 4	21-07 10 70 70	G1070.70	32 70 00	Wetlands	100	2D-	Civil
Level 4	21-07 10 70 80	G1070.80	35 73 13	Earth Dams	100	2D-	Civil
Level 4	21-07 10 70 90	G1070.90	31 31 00	Site Soil Treatment	100	2D-	Civil
Level 2	21-07 20	G20		SITE IMPROVEMENTS	•	•	Civil
Level 3	21-07 20 10	G2010		Roadways	•	•	Civil
Level 4	21-07 20 10 10	G2010.10	32 10 00	Roadway Pavement	300	3D+	Civil
Level 4	21-07 20 10 20	G2010.20	32 16 13	Roadway Curbs and Gutters	300	3D+	Civil
Level 4	21-07 20 10 40	G2010.40	32 17 00	Roadway Appurtenances	300	2D+	Civil
Level 4	21-07 20 10 70	G2010.70	26 56 19	Roadway Lighting	300	3D+	Civil, Electrical
Level 4	21-07 20 10 80	G2010.80	34 52 00	Vehicle Fare Collection	300	3D+	Specialty Consultants
Level 3	21-07 20 20	G2020		Parking Lots	•	•	Civil
Level 4	21-07 20 20 10	G2020.10	32 10 00	Parking Lot Pavement	300	3D+	Civil
Level 4	21-07 20 20 20	G2020.20	32 16 13	Parking Lot Curbs and Gutters	300	3D+	Civil
Level 4	21-07 20 20 40	G2020.40	32 17 00	Parking Lot Appurtenances	300	2D+	Civil
Level 4	21-07 20 20 70	G2020.70	26 56 16	Parking Lot Lighting	300	3D+	Civil, Electrical
Level 4	21-07 20 20 80	G2020.80	11 12 00	Exterior Parking Control Equipment	200	3D+	Architectural, Civil, Electrical
Level 3	21-07 20 30	G2030		Pedestrian Plazas and Walkways	•	•	Civil
Level 4	21-07 20 30 10	G2030.10	32 10 00	Pedestrian Pavement	300	3D+	Civil

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Level	**OmniClass ID**	**UniFormat ID**	**Master Format ID**	**Element ID**	**LOD**	**GRADE**	**Primary Discipline (This will allow design team to identify discipline specific areas of content)**
Level 4	**21-07 20 30 20**	**G2030.20**	**32 16 13**	**Pedestrian Pavement Curbs and Gutters**	300	3D+	Civil
Level 4	**21-07 20 30 30**	**G2030.30**		**Exterior Steps and Ramps**	300	3D+	Civil
Level 4	**21-07 20 30 40**	**G2030.40**	**32 17 00**	**Pedestrian Pavement Appurtenances**	300	2D+	Civil
Level 4	**21-07 20 30 70**	**G2030.70**	**26 56 33**	**Plaza and Walkway Lighting**	300	3D+	Civil, Electrical
Level 4	**21-07 20 30 80**	**G2030.80**	**11 14 00**	**Exterior Pedestrian Control Equipment**	300	3D+	Architectural, Civil, Electrical
Level 3	**21-07 20 40**	**G2040**		**Airfields**	•	•	Civil
Level 4	**21-07 20 40 10**	**G2040.10**	**32 10 00**	**Aviation Pavement**	300	3D+	Civil
Level 4	**21-07 20 40 20**	**G2040.20**	**32 16 13**	**Aviation Pavement Curbs and Gutters**	300	3D+	Civil
Level 4	**21-07 20 40 40**	**G2040.40**	**32 17 00**	**Aviation Pavement Appurtenances**	300	2D+	Civil
Level 4	**21-07 20 40 70**	**G2040.70**	**26 56 00**	**Airfield Lighting**	300	3D+	Civil, Electrical, Specialty Consultants
Level 4	**21-07 20 40 80**	**G2040.80**	**34 43 00**	**Airfield Signaling and Control Equipment**	300	3D+	Civil, Electrical, Specialty Consultants
Level 3	**21-07 20 50**	**G2050**		**Athletic, Recreational, and Playfield Areas**	•	•	Civil
Level 4	**21-07 20 50 10**	**G2050.10**		**Athletic Areas**	200	2D+	Civil
Level 4	**21-07 20 50 30**	**G2050.30**		**Recreational Areas**	200	2D+	Civil
Level 4	**21-07 20 50 50**	**G2050.50**		**Playfield Areas**	200	2D+	Civil
Level 3	**21-07 20 60**	**G2060**		**Site Development**	•	•	Civil
Level 4	**21-07 20 60 10**	**G2060.10**	**13 12 13**	**Exterior Fountains**	300	3D+	Architectural, Civil, Electrical, Plumbing, Specialty Consultants, Structural
Level 4	**21-07 20 60 20**	**G2060.20**	**32 31 00**	**Fences and Gates**	300	3D+	Civil
Level 4	**21-07 20 60 25**	**G2060.25**	**12 93 00**	**Site Furnishings**	200	3D+	Civil
Level 4	**21-07 20 60 30**	**G2060.30**	**10 14 00**	**Exterior Signage**	200	3D+	Civil, Specialty Consultants
Level 4	**21-07 20 60 35**	**G2060.35**	**10 75 00**	**Flagpoles**	300	3D+	Architectural, Civil, Landscape
Level 4	**21-07 20 60 40**	**G2060.40**	**10 73 00**	**Covers and Shelters**	300	3D+	Architectural, Civil, Structural
Level 4	**21-07 20 60 45**	**G2060.45**	**10 84 13**	**Exterior Gas Lighting**	300	3D+	Civil, Plumbing
Level 4	**21-07 20 60 50**	**G2060.50**		**Site Equipment**	300	3D+	Civil
Level 4	**21-07 20 60 60**	**G2060.60**	**32 32 00**	**Retaining Walls**	300	3D+	Civil, Specialty Consultants, Structural
Level 4	**21-07 20 60 70**	**G2060.70**	**32 34 00**	**Site Bridges**	300	3D+	Civil, Specialty Consultants, Structural
Level 4	**21-07 20 60 80**	**G2060.80**	**32 35 00**	**Site Screening Devices**	300	3D+	Architectural, Civil, Structural
Level 4	**21-07 20 60 85**	**G2060.85**	**32 39 00**	**Site Specialties**	300	3D+	Civil
Level 3	**21-07 20 80**	**G2080**		**Landscaping**	•	•	Civil
Level 4	**21-07 20 80 10**	**G2080.10**	**32 84 00**	**Planting Irrigation**	100	2D+	Civil

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Level 4	21-07 20 80 20	G2080.20	32 92 00	Turf and Grasses	200	2D+	Civil
Level 4	21-07 20 80 30	G2080.30	32 93 00	Plants	200	2D+	Civil
Level 4	21-07 20 80 50	G2080.50	32 94 00	Planting Accessories	200	2D+	Civil
Level 4	21-07 20 80 70	G2080.70	26 56 26	Landscape Lighting	200	2D+	Civil, Electrical
Level 4	21-07 20 80 80	G2080.80		Landscaping Activities	200	2D+	Civil, Specialty Consultants
Level 2	21-07 30	G30		LIQUID AND GAS SITE UTILITIES	•	•	Civil
Level 3	21-07 30 10	G3010	33 10 00	Water Utilities	•	•	Civil
Level 4	21-07 30 10 10	G3010.10		Site Domestic Water Distribution	300	3D+	Civil
Level 4	21-07 30 10 30	G3010.30		Site Fire Protection Water Distribution	300	3D+	Civil
Level 4	21-07 30 10 50	G3010.50		Site Irrigation Water Distribution	300	3D+	Civil
Level 3	21-07 30 20	G3020	33 30 00	Sanitary Sewerage Utilities	•	•	Civil
Level 4	21-07 30 20 10	G3020.10		Sanitary Sewerage Utility Connection	300	3D+	Civil
Level 4	21-07 30 20 20	G3020.20	33 31 00	Sanitary Sewerage Piping	300	3D+	Civil
Level 4	21-07 30 20 40	G3020.40	33 36 00	Utility Septic Tanks	300	3D+	Civil
Level 4	21-07 30 20 50	G3020.50	33 39 00	Sanitary Sewerage Structures	300	3D+	Civil
Level 4	21-07 30 20 60	G3020.60	33 47 23	Sanitary Sewerage Lagoons	300	3D+	Civil
Level 3	21-07 30 30	G3030	33 40 00	Storm Drainage Utilities	•	•	Civil
Level 4	21-07 30 30 10	G3030.10		Storm Drainage Utility Connection	300	3D+	Civil
Level 4	21-07 30 30 20	G3030.20	33 41 00	Storm Drainage Piping	300	3D+	Civil
Level 4	21-07 30 30 30	G3030.30	33 42 00	Culverts	300	3D+	Civil
Level 4	21-07 30 30 40	G3030.40	33 44 00	Site Storm Water Drains	300	3D+	Civil
Level 4	21-07 30 30 50	G3030.50	33 45 00	Storm Drainage Pumps	300	3D+	Civil
Level 4	21-07 30 30 60	G3030.60	33 46 00	Site Subdrainage	300	3D+	Civil
Level 4	21-07 30 30 70	G3030.70	33 47 26	Storm Drainage Ponds and Reservoirs	300	3D+	Civil
Level 3	21-07 30 50	G3050		Site Energy Distribution	•	•	Mechanical (HVAC)
Level 4	21-07 30 50 10	G3050.10	33 61 00	Site Hydronic Heating Distribution	300	3D+	Mechanical (HVAC)
Level 4	21-07 30 50 20	G3050.20	33 63 00	Site Steam Energy Distribution	300	3D+	Mechanical (HVAC)
Level 4	21-07 30 50 40	G3050.40	33 61 00	Site Hydronic Cooling Distribution	300	3D+	Mechanical (HVAC)
Level 3	21-07 30 60	G3060		Site Fuel Distribution	•	•	Mechanical (HVAC)
Level 4	21-07 30 60 10	G3060.10	33 41 00	Site Gas Distribution	300	3D+	Mechanical (HVAC)
Level 4	21-07 30 60 20	G3060.20	33 52 13	Site Fuel-Oil Distribution	300	3D+	Mechanical (HVAC)
Level 4	21-07 30 60 30	G3060.30	33 52 16	Site Gasoline Distribution	100	3D+	Specialty Consultants
Level 4	21-07 30 60 40	G3060.40	33 52 19	Site Diesel Fuel Distribution	100	3D+	Specialty Consultants
Level 4	21-07 30 60 60	G3060.60	33 52 43	Site Aviation Fuel Distribution	100	3D+	Specialty Consultants

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Level 3	**21-07 30 90**	**G3090**		**Liquid and Gas Site Utilities Supplementary Components**	•	•	Specialty Consultants
Level 4	**21-07 30 90 10**	**G3090.10**		**Supplementary Components**	100	2D+	Specialty Consultants
Level 2	**21-07 40**	**G40**		**ELECTRICAL SITE IMPROVEMENTS**	•	•	Electrical
Level 3	**21-07 40 10**	**G4010**		**Site Electric Distribution Systems**	•	•	Electrical
Level 4	**21-07 40 10 10**	**G4010.10**	**33 71 73**	**Electrical Utility Services**	200	3D+	Electrical
Level 4	**21-07 40 10 20**	**G4010.20**	**33 71 00**	**Electric Transmission and Distribution**	200	3D+	Electrical
Level 4	**21-07 40 10 30**	**G4010.30**	**33 72 00**	**Electrical Substations**	200	3D+	Electrical
Level 4	**21-07 40 10 40**	**G4010.40**	**33 73 00**	**Electrical Transformers**	200	3D+	Electrical
Level 4	**21-07 40 10 50**	**G4010.50**	**33 75 00**	**Electrical Switchgear and Protection Devices**	200	3D+	Electrical
Level 4	**21-07 40 10 70**	**G4010.70**	**33 79 00**	**Site Grounding**	200	2D+	Electrical
Level 4	**21-07 40 10 90**	**G4010.90**	**33 09 70**	**Electrical Distribution System Instrumentation and Controls**	200	2D+	Electrical
Level 3	**21-07 40 50**	**G4050**	**26 56 29**	**Site Lighting**	•	•	Civil, Electrical
Level 4	**21-07 40 50 10**	**G4050.10**	**26 56 23**	**Area Lighting**	300	3D+	Electrical
Level 4	**21-07 40 50 20**	**G4050.20**	**26 56 36**	**Flood Lighting**	300	3D+	Electrical
Level 4	**21-07 40 50 50**	**G4050.50**		**Building Illumination**	300	3D+	Electrical
Level 4	**21-07 40 50 90**	**G4050.90**		**Exterior Lighting Supplementary Components**	100	2D+	Electrical
Level 2	**21-07 50**	**G50**		**SITE COMMUNICATIONS**	•	•	Electrical
Level 3	**21-07 50 10**	**G5010**	**33 80 00**	**Site Communications Systems**	•	•	Electrical
Level 4	**21-07 50 10 10**	**G5010.10**	**33 81 00**	**Site Communications Structures**	200	3D+	Electrical
Level 4	**21-07 50 10 30**	**G5010.30**	**33 82 00**	**Site Communications Distribution**	200	3D+	Electrical
Level 4	**21-07 50 10 50**	**G5010.50**	**33 83 00**	**Wireless Communications Distribution**	200	3D+	Electrical
Level 2	**21-07 90**	**G90**		**MISCELLANEOUS SITE CONSTRUCTION**	•	•	Civil
Level 3	21-07 90 10	G9010	31 70 00	Tunnels	•	•	Civil
Level 4	**21-07 90 10 10**	**G9010.10**		**Vehicular Tunnels**	200	3D+	Civil
Level 4	**21-07 90 10 20**	**G9010.20**		**Pedestrian Tunnels**	200	3D+	Civil
Level 4	**21-07 90 10 40**	**G9010.40**		**Service Tunnels**	200	3D+	Civil
Level 4	**21-07 90 10 90**	**G9010.90**		**Tunnel Construction Related Activities**	200	2D-	Civil

END OF SECTION 00 00 08-02

SECTION 00 00 08-03 – AUTOCAD REQUIREMENTS

PART 1 - General

1.1 This section describes the electronic and print deliverable expectations when AutoCAD is used to produce the Construction Documents

A. AutoCAD 2018 or newer. Only 2 dimensional, non-propriety, base AutoCAD objects shall be used.

B. Single .DWG file per floor. Use standard fonts, etc. supplied with base AutoCAD. All pages to include a graphic scale (readable on 8 ½ X 11 pages, a north arrow and the name of the facility.

C. Layers:
1. Follow AIA Layering guidelines
2. Floor plan (walls, windows and door swings)
3. Furniture
4. Room Name
5. Equipment
6. Security (cameras, motions, keypads)
7. Plumbing (fixtures)
8. Graphic Scale readable on 8 ½" x 11"
9. North Arrow
10. Room Numbers

D. The ability to plot a Composite floor plan (per floor), where room numbers and names can be read easily (down to, and especially 8 ½" x 11")

E. Drawings shall reflect As-Built conditions; no demolition plans (Base Plan ONLY).

F. All drawings should be printed in 8 ½ x 11 and in .PDF electronically, is the end result desired. This will allow printing in 8 ½" x 11", 11" x 17", etc.

G. Color settings for Black on White.

H. Supply "pen table" file.

END OF SECTION 00 00 08-03

Division 01 – General Requirements

01 00 00	General
01 10 00	Summary
01 20 00	Price and Payment Procedures
01 30 00	Administrative Requirements
01 40 00	Quality Requirements
01 50 00	Temporary Facilities and Controls
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01 70 00	Execution and Closeout Requirements

Division 01 – General Requirements

SECTION 01 00 00 – GENERAL

PART 2 - General

2.1 This standard provides general guidance for the development of appropriate sections of Division 1 of the specifications and contract documents.

2.2 It is recognized that the ACCD Design and Construction Standards will apply to all campuses with varying Division 1 requirements depending on the nature of the work and campus specific requirements.

2.3 All sections in this division are briefly covered with the intent of alerting the design professional of conditions that may be present on any one or all campuses.

END OF SECTION 01 00 00

Division 01 – General Requirements

SECTION 01 10 00 – SUMMARY

PART 1 - Summary of Work

1.1 The design professionals shall provide a complete summarized description of the work including the following topics, as applicable.

A. An accurate description of the work covered by the contract documents.

B. An accurate description of any portion of the work to be provided by ACCD.

C. An accurate description of the work to be provided by owner-purchased contracts.

1.2 Multiple Contract Summary

A. The design professionals shall provide a complete description of the work provided under multiple contracts, as applicable.
   1. An accurate summary of the work provided under each contract.
   2. An accurate description of the Work Sequence relating to each contract, as applicable.
   3. An accurate description of contract interface among the multiple contractors.

1.3 Work Restrictions

A. The design professionals shall provide a complete description of restrictions to the work including the following.
   1. An accurate description of access to the site, that interfaces with a pictorial description on the contract drawings.
   2. A complete description of coordination requirements with occupants including coordination with campus/building occupants, ACCD's project manager and campus leadership, as applicable.
   3. A description of ACCD's use of site should be included where occupancy and/or use of site coincides with construction.
   4. An accurate description of the intended use of the site coordinated with a pictorial description on the contract drawings.

1.4 Project Utility Sources

A. The design professional shall determine and clearly identify the providers of all utilities affecting the work on the site including but not limited to:
   1. Public service provider(s) for electric, water and gas.
   2. Campus utility/data system

3. Telephone company provider
4. Television/cable provider
5. Security systems provider
6. Campus energy management provider

END OF SECTION 01 10 00

SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 - Allowances

1.1 The design professional shall avoid the use of cash allowances unless specifically approved by ACCD's Director of Construction.

A. Budget allowances for contingency, testing and inspection shall be ACCD's responsibility and included in the project budget.

B. Design professionals shall coordinate with ACCD's project manager to determine the municipal development fees, pro- rata assessments, and other development costs not normally provided by the contractor as a part of the construction process.

C. Rain and mud days and resulting requests for contract time extension shall be clearly established in the contract documents using the TXDOT standard methodology.

Resources such as FEMA and the Corps of Engineers Reports may be utilized as back-up information.

The contractor shall be required to identify rain and/or mud days as they occur on a monthly basis. Each delay requested shall be identified by date and its impact on the critical path of the work an critical path of the presented to ACCD's project manager for consideration at the time of submittal of the application for payment. Under no circumstances will extensions of time due to weather be a subject for reimbursement of cost.

D. Quality Control

1. Additional costs encountered during project construction phases may be avoided or minimized if adequate information is obtained during the programming definition, budgeting and design processes. This allows value engineering options to be considered and decisions reached initially rather than late in the program where construction and budgets will be adversely affected.

1.2 Unit Prices

A. The design professional shall establish the unit prices applicable for each project and provide in the contract documents a listing of each item. The contract documents shall establish a base amount with spaces for the unit cost of adding additional units and a space for deducting units in a plus and minus format per item.

1. Where the possibility of concrete pier casings exist, the design professional shall provide all piers with casings as a part of the base contract with unit price deducts per foot and per each when casings are shorter or not used. Refer to section 31 63 29.

2. Payment for unit price changes shall be computed on the aggregate of additions and deducts per item.

1.3 Alternates

A. The design professional shall judiciously use alternates as a method of budget control as well as to establish the value of certain design elements for final consideration by ACCD.

B. In establishing elements, the design professional shall use care to adequately define the scope of the alternate within the scope of the contract and bidding documents. Give clear consideration to the impact on the contract documents if the alternate is not selected.

C. Develop alternates using the following steps:
1. Work included in alternates shall be clearly identified in drawings and specifications by alternate numbers.
2. The cost of each alternate is the net addition to the contract sum to incorporate the alternate into the scope of work.
3. All alternates will be Add alternates (Avoid deductive alternates).
4. Alternates quoted on bid forms to be reviewed and accepted or rejected at ACCD's option.
5. Accepted alternates should be identified in the owner- contractor agreement.
6. Coordinate related work and clearly indicate modification of surrounding work required to integrate each alternate.

1.4 Value Analysis

A. Value analysis or value engineering is the design professional's "review and audit" of the design effort to provide ACCD the best solution to the program requirements in the most cost-effective manner (the most bang for the buck).

B. The most effective use of value engineering occurs during the early concept and design phases of the project. Value engineering as a correction for budget busting should be avoided by performing good planning, cost estimating and budget adherence. The value engineering process should include the design professional and his consultants, ACCD's project team and any other party that could provide relevant information.

1.5 Substitution Procedures

A. The design professional shall clearly and fairly define the procedure and timeline for substitutions to the specified materials, systems and installation. If alternative suppliers and/or products are properly listed in the contract documents for each section, the design professional and ACCD has greater control over substitutions and the contractor has other alternatives to submit on his bid.

B. Substitutions after award of the contract should not be allowed unless the contractor presents compelling reasons that are accepted by the design professional and ACCD. Price should not be used as a compelling reason.

1.6 Contract Modification Procedures

A. The design professional shall use every effort within his professional standard of care to provide documents that are complete, coordinated, clear, and concise thus avoiding modifications to the contract.

B. Where modifications to the contract are required to provide for scope changes, omissions to the contract documents and unforeseen conditions, the procedure clearly established in the following manner:

1. Changes initiated by the design professional and/or ACCD shall start with an ASI or RFP issued to the contractor advising a potential change to the scope of work.
2. The contractor shall respond within 5- 10 business days, or and time impact as agreed to with the project manager, with a proposed cost of the work. The cost shall be supported with sufficient detail documents allowing ACCD and the design professionals to make an informed decision.
3. Conditions requiring changes initiated by the contractor shall be directed to the design professional for consideration and response using an RFI. The design professional will respond within 5-10 business days, or as agreed to with the project manager, by issuing a response or an RFP to establish a cost for the change, if appropriate.
4. The process will culminate in the issuance of a change order following consideration of the RFP response and approval of by ACCD.
5. Change orders of $50,000 and greater will require action by the Board of Trustees of ACCD.
6. Minor changes in the work, field orders, and change directives may be effected pending approval by the Director of Construction.
7. A Construction Change Directive is a method of requiring the contractor to proceed with work prior to the final agreement of both parties, where there is a disagreement in the contract amount and/or contract time.

   This method should be used judiciously where work is required and needs to proceed without impacting the overall project schedule or the work of others. This is sometimes necessary when there is a disagreement on the proposed amount, start time or an extension to the contract time.
8. If agreement is reached, the Construction Change Directive is converted to a change order. If an agreement is not reached, the contractor retains his rights to appeal for remedies as established in the contract.

1.7 Payment Procedures

A. The design professional shall provide instructions in the contract documents that clearly outline payment procedures to be followed by both ACCD and the contractor. The following are key steps in the process:
   1. A Notice to Proceed (NP) issued following the receipt of a signed agreement, required insurance policy information and the required payment and performance bonds.
   2. Submittal and acceptance of a detailed Schedule of Values.
   3. Submittal and acceptance of a Master Project Schedule.
   4. Monthly reviews of as-built drawings kept at the contractor's job site office.

B. Following receipt of the above items, each pay request shall be provided to the design professional on the twenty-fifth of the month in draft form and a scheduled review of the project progress with ACCD's project manager, the manager of the design team, and the contractor.
   1. Applications for payment will include the approved payment request incorporating any changes agreed upon as a part of the project review.
   2. Adjustments to the project schedule shall be provided with the application for payment. Adjustments made to the project schedule due to rain or mud days must be documented and submitted for the current application period.

END OF SECTION 01 20 00

Division 01 – General Requirements

SECTION 01 30 00 – ADMINISTRATIVE REQUIREMENTS

1.1 Project Management and Coordination

A. ACCD assumes the role of Program Manager on all work, both large and small, that is under design and construction on the various campuses. All projects will have a project/construction manager assigned to the project who manages the design and construction thus relating to the design professionals well as to the contractor(s).

B. On projects where a consultant project/construction manager is not engaged, the district assumes the roles of both program and project manager and interfaces directly with design professionals and contractors.

C. Regardless of who is performing the role of the project/construction manager that position is referred to throughout this Design and Construction Standards guide as ACCD's project manager.

D. Project Coordination

1. Project coordination will be the initial responsibility of ACCD's Construction Department, who will assign the project manager. It is the design professional's role to understand and participate with ACCD's project manager in the overall coordination of the project as a resource to ACCD.

E. Multiple Project Coordination

1. Project coordination will be the initial responsibility of ACCD's Construction Department and ACCD's program manager working in coordination with the individual project managers. It is the design professional's role to understand and participate with ACCD's project manager in the overall coordination of the project as a resource to ACCD.

F. Project Meetings

1. ACCD's project manager is responsible for conducting project meetings. The design professional shall participate in project meetings as a resource and provide technical input, interpretation of the contract documents as may be required, and approvals or rejections of elements of the work within the scope of his authority.

G. Project meetings are as follow:

1. Preconstruction Meetings; where the roles of the participants are clearly established and the logistics of the construction process are discussed.
2. Site mobilization Meetings; will resolve such issues as: location of contractor facilities, storage areas, site use and access etc.
3. Progress Meetings; will be regularly scheduled on bi-monthly intervals and will be attended by the contractor's project manager, job superintendent, major sub-contractors and suppliers (as required), ACCD's project manager, and manager of the design team, and other design professionals as required.

4. These meetings, chaired by ACCD's project manager, will follow an agenda including the following:
   a. Review minutes of previous meetings.
   b. Review progress of construction.
   c. Field observations, questions and decisions.
   d. Identification of unforeseen conditions which impede planned progress.
   e. Review of submittals schedule and status of submittals.
   f. Review of RFIs
   g. Review of RFPs CCDs COs
   h. Review of off-site fabrication and delivery schedules.
   i. Maintenance of progress schedule.
   j. Corrective measures to regain projected schedules.
   k. Planned progress during succeeding work period.
   l. Coordination of projected progress.
   m. Maintenance of quality and work standards.
   n. Effect of proposed changes on progress schedule and coordination.
   o. Updates to record drawings.
   p. Other business relating to the project.
5. Pre -installation Meetings; will be held at various stages during the project and required for each major trade before commencing that phase of work. The design professional shall provide a list of those work units where a pre-installation meeting is required and review the terms required for the performance of the work. Example: roofing conference prior to installation of roof insulation, flashing and roofing.
6. Project Web Site; On larger capital projects, ACCD's program manager and/or project manager will establish a project web site and the design professional will be asked to participate in providing information, drawings etc. to the web site as appropriate.

1.2 Construction Progress Documentation

A. It is the design professional's responsibility to review schedules, submittals, construction progress reports and provide written Site Observation Reports with photographs as appropriate and noting findings at each visit to the site. Progress documentation should be furnished to ACCD's project manager with copies to the contractor. Frequency of site visits and reports should occur no less than weekly and more frequently if needed to fulfill the terms of the contract.

1.3 Submittal Procedures

A. These items are important elements of the quality control process that allows the professional to develop a level of quality both in product materials and performance of the contractor, installers and suppliers.

B. Certificates

Design professionals shall include in the contract documents a clear definition of certificates required from manufacturers, installers, technicians and others as may be applicable. These requirements shall occur in the quality control section of each part of the specifications.

C. Design Data

Design professionals shall specify design data requirements of each product as required to provide assurance that the product meets the design performance intent of the specifications.

D. Field Test Reporting

Design professionals shall require field test reports on each element of the work where adherence to quality and design standards can only determine by field testing the installed product such as: concrete, asphalt, compacted earth and sub-grade materials etc.

1. Geophysical and material testing shall be accomplished by the same technical source that prepared the initial design requirements.

E. Submittals Samples

Design professionals shall specify in each section of the specifications the requirement for shop drawings, product data, or samples to be submitted for review and comment by the design team and ACCD.

1. Shop drawings of items of work with sufficient detail for both the design team and the installers to clearly understand the level of quality required. These shall be specified by quantity and size to meet the project requirements.
2. It is the responsibility of the contractor to thoroughly review and check shop drawings prior to submitting to the design professional and this should be emphasized in the contract documents.
3. Design professionals shall require product data on materials being submitted for installation.
4. The design professional shall require samples for selected materials for design team and ACCD approval. This requirement is a quality control feature specifically relevant to the following.
   a. Color and texture of materials, e.g. brick, marble and other building materials
   b. The design professional should require mock-ups of certain elements of the work i.e. masonry, exterior walls, etc.
   c. System samples such as window wall systems and connections, lay-in ceiling systems.
   d. Specific equipment such as hardware, accessories etc.

F. Submittals shall be made in a quantity sufficient to satisfy the project needs.

G. The design professional shall keep a submittal register showing submittals required for all items on the project and the status of each. The register shall record the following:

1. Specification section and item
2. Date received

3. Action taken
4. Date released

H. Submittals that fail to meet minimum standards shall be corrected, re-submitted and logged in the same manner.

I. Source Quality Control Reporting; In order to maintain the quality control process, the design professional shall require that the contractor provide literature, reports etc. of building products directly from the manufacturer to ensure that the product being submitted meets the specification requirements.

J. Quality Control

1. Additional costs encountered during project construction phases may be avoided or minimized if adequate information is obtained during the programming, Programing definition, budgeting and design processes. This allows value engineering options to be considered and decisions reached initially rather than late in the program where construction and budgets will be adversely affected.

1.4 Special Procedures

A. The design professional shall discuss any special procedures required for a project as part of the programing definition phase (refer to 00 00 01 of the Design and Construction guide lines), and work with the manager of the design team and the project manager in finalizing the all procedures. Special project procedures can include the following(not included in these standards)

1. Special Project Procedures
2. Special Project Procedures for Healthcare Facilities
3. Special Project Procedures for Contaminated Sites
4. Owner Safety Requirements
5. Health, Safety, and Emergency Response Procedures
6. Environmental Procedures
7. Security Procedures
8. Historic Treatment Procedures

END OF SECTION 01 30 00

Division 01 – General Requirements

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 - Quality Requirements

1.1 Regulatory Requirements

A. Design professionals shall provide a complete listing of regulatory agencies that will have jurisdiction over the projects. The following items should be included, as applicable to alert the contractor to the responsibilities of the design and construction team.
   1. Federal requirements such as EPA storm water control, hazardous material regulations OSHA standards, ADA and Texas Accessibility Standards
   2. Municipal regulation analysis such as zoning classification, landscape ordinance compliance and
   3. Historic Review Committee requirements. The design professionals shall participate with ACCD's representatives to provide all pertinent data and attend required site visits and meetings of the committee in an effort gain design approval as may be required.

B. Codes
   1. The design professional shall provide design and construction documents within the parameters of the existing codes affecting the project. Documents shall be noted as to the code requirements. Include a listing of applicable codes used. Examples are current editions of:
      a. Applicable building codes with effective dates.
      b. Design codes such as structural, mechanical, plumbing, electrical, NFPA, life safety, health code and other relevant codes.

C. Codes and Standards to be used are listed in the Design and Construction Standards Introduction 00 00 00.

D. Design professionals shall provide a code summary on the general information sheet of the drawings and include the following:
   1. Building description with gross square feet, number of stories, and fire-sprinkled inclusion.
   2. Type of construction defining building area and allowed building height.
   3. Occupancy classification providing group, new construction, renovation, as applicable.
   4. Occupancy separation providing a rating separation, as applicable.
   5. Fire protection systems establishing fire sprinkler and alarm inclusion.
   6. Structural fire rating providing rating by hours and UL design assembly.
   7. Wall construction providing rating by hours and UL design assembly.
   8. Roof construction providing rating by hours and UL design assembly.
   9. Column construction providing rating by hours and UL design assembly.

E. Design professionals shall provide an analysis of occupancy loads on the drawing, indicating location, use, area, square feet per person and number of persons

F. Laws
1. Design professionals shall provide services strictly recognizing the professional licensing requirements and laws of the land; and require adherence to those laws by the contractor, subcontractors, sub- subcontractors and material suppliers.

G. Rules
1. Design professionals shall be thoroughly familiar with the rules, regulations and procurement policies adopted by ACCD and include these requirements in Division 0 of the project specifications.

H. Fees
1. Design professionals shall provide a complete listing of all fees required as part of the design and construction process:
   a. Fees that are the responsibility of ACCD such as assessments and related developer costs.
   b. Fees that are the responsibility of the contractor such as all building permit-associated fees.
   c. Fees that are the responsibility of the design professional such as ADA review fees or municipal review fees, as applicable.

I. Permits
1. The design professional shall, in consultation with ACCD's program manager and/or project manager, determine the Party responsible for submitting construction documents and monitoring the review process pursuant to receiving a building permit.
2. Regardless of the submitting party, the design professional is responsible for the preparation and submittal of responses to review comments generated by regulatory authorities and any document adjustments required.

1.2 References

A. Abbreviations and Acronyms
1. Abbreviations and acronyms shall be defined in the drawing legends and shall be consistent with those generally used in the profession. In addition, these abbreviations and acronyms shall be consistent in their use throughout the contract documents.

B. Definitions
1. Definitions generally will occur as a part of the General Conditions of the Contract for Construction and ACCD Supplementary Conditions. If the design professional needs to extend definitions into technical sections to adequately describe the product or the system, those definitions should be included in the technical specifications.

C. Reference Standards

1. Reference standards shall be provided in every section of the technical specifications as appropriate. The design professional shall use every effort to provide current and appropriate references relating to the section of work involved.

1.3 Quality Assurance

A. The first step in providing quality assurance is the design professional's requirement for the qualifications of the contractor, his subcontractors, material suppliers and installers. Each section of the specifications shall list those qualification requirements appropriate to the work of the section, including the number of years of satisfactory service or experience. A list of those requirements are:
   1. Manufacturer Qualifications
   2. Supplier Qualifications
   3. Fabricator Qualifications
   4. Installer Qualifications
   5. Testing and inspecting Agency Qualifications
   6. Code-Required Special Inspector qualifications
   7. Manufacturer's Field Services
   8. Field Samples
   9. Mockups

1.4 Quality Control

A. The design professional shall establish quality control procedures appropriate for the project in each section, as appropriate, of the technical specifications. This process will define the specific procedures required. Levels of quality control are as follows:

B. Source Quality Control Procedures; these quality control procedures are required at the manufacturing or production location.

C. Field Quality Control Procedures; involve the quality control process with members of the manufacturer and the contractor.
   1. Design Professional Quality Control; shall establish quality control requirements of the manufacturer or his designated, trained representatives to assure installation quality. Special conditions such as roofing, waterproofing and finishes are examples.
   2. Contractor Quality Control; shall be provided by the general contractor. The design professional shall require that the general contractor provide a written quality-control plan to be reviewed by the manager of the design team and ACCD's project manager. This shall include a contractor representative whose exclusive job is quality control with an on-going schedule of quality control meetings with project personnel.

D. Testing and Inspecting Services

1. Testing and inspecting services shall be provided by the testing laboratory selected by ACCD. The design professional, working with ACCD's project manager, shall establish that work for testing and inspection services.

E. Plant Inspection Procedures
1. The design professional shall establish that level of work requiring plant inspection procedures as appropriate to the project. An example is the construction of millwork, casework and special equipment.

F. Testing Laboratory Services
1. Testing laboratory services shall be provided by a testing laboratory selected by ACCD for testing services scope identified by the design professional in specification sections" Testing Laboratory Services".

G. Code -Required Special Inspection and Procedures
1. These inspections and procedures are those required by municipal, state or federal regulations and shall be referred to in the specifications by reference to code or specific inclusion. ADA, electrical, plumbing and mechanic al as well as structural inspections are examples.

END OF SECTION 01 40 00

Division 01 – General Requirements

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - Temporary Facility and Controls

1.1 Temporary Utilities

A. Temporary utilities are the responsibility of the contractor. The design professional shall establish with ACCD's project manager any services that may be made available to the construction project and the terms of use, if any. The following list represents services generally required on all projects.
   1. Temporary Electricity
   2. Temporary Fire Protection
   3. Temporary Fuel Oil
   4. Temporary Heating, Cooling, and Ventilating
   5. Temporary Lighting
   6. Temporary Natural-Gas
   7. Temporary Telecommunications
   8. Temporary Water

1.2 Construction Facilities

A. The design professional shall identify in the contract documents, the requirements for field offices, staging area and on-site storage. The field office shall contain first aid facilities.

B. The field office shall provide sufficient space for the contractor's administration of the project as well as a conference/meeting facility to accommodate a 20-person project meeting.

C. The contractor shall be directed to provide sanitary facilities to serve the project construction personnel. These shall exclude existing toilet rooms in all projects, particularly those where renovation is involved.

1.3 Vehicular Access and Parking

A. In concert with ACCD's project manager, the design professional shall provide a general description outlining the following temporary facilities required for the project: The following vehicular access and parking items shall be coordinated with the Alamo Community College Department of Public Safety.

B. Temporary Access Roads

Temporary Access Roads may be required to service the site without impacting student and faculty vehicular and pedestrian flow.

C. Haul Routes
1. The contract drawings shall establish haul routes when required to avoid unnecessary congestion and as a safety measure with respect to student and faculty campus usage.

D. Temporary Parking Areas
1. Parking is at a premium at each established campus and following the district's mandate that students come first, construction parking will generally not be provided. The contractor, therefore, should be directed to provide other means of construction project parking.
2. Where temporary parking is required to accommodate student and faculty vehicles while new facilities are being provided; these locations shall be clearly designated as a part of the scope of work.

E. Temporary Roads
1. The design professional shall determine if temporary access roads are required to avoid construction and new improvements.

F. Traffic Control
1. The design professional shall require that the contractor provide temporary traffic control personnel, signage and barriers as required by contract conditions.

1.4 Temporary Barriers and Enclosures

A. The dust and noise of the construction process is in direct conflict with education and learning. The design professional should be aware of this and instruct the contractor, as a part of the contract documents, to provide the following temporary barriers and enclosures:
1. Temporary Air Barriers
2. Temporary Dust Barriers
3. Temporary Noise Barriers
4. Temporary Barricades
5. Temporary Fencing
6. Temporary Protective Walkways
7. Temporary Tree and Plant Protection

B. Temporary tree and plant protection shall be strictly observed and maintained as a part of the requirements of the regulatory authorities landscape and tree ordinances.

1.5 Temporary Controls

A. Temporary control of various elements of the site during the construction process is covered in the civil and landscape sections of these standards. The design professional shall verify that each of the following controls are in place:

1. Erosion and Sediment
2. Temporary Pest Control
3. Temporary Environmental Control
4. Temporary Storm Water Pollution Control

1.6 Project Identification

A. The design professional shall require the contractor to provide temporary project signage as appropriate for the scope of work. Signage shall be presented and approved by ACCD's project manager and shall include temporary interior signage required for direction, information, and safety.

B. Project signs for general project information and participants to be provided by the contractor shall be designed by the design professional and both the design and location shall be approved by ACCD's project manager. The design professional shall restrict trade signs and advertisements and all signage shall be appropriate for an educational facility.

END OF SECTION 01 50 00

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 - Product Requirements

1.1 Owner Supplied Products

A. Owner supplied products may consist of furniture, office equipment, telecommunication systems, specialized equipment such as theatre, studios, laboratories and athletic equipment not included in the scope of the contractor's work.

B. Design professionals shall provide in the contract documents the comment that the appropriate vendors will cooperate with ACCD's forces to allow for delivery and installation of the products. ACCD to provide appropriate notice of the delivery and installation schedule to the contractor

END OF SECTION 01 60 00

Division 01 – General Requirements

SECTION 01 70 00 – EXECUTION AND CLOSEOUT REQUIREMENT

PART 1 - Execution and Close Out Requirements

1.1 In developing this section of the contract documents, the design professional shall use care in providing an accurate description of the contractor's duties to understand the scope of work, to examine the site and existing facilities and to define the execution of the contract to meet the program requirements. The following areas, therefore, shall be included:

A. Examination and Preparation
   1. The design professional shall require the contractor to make a careful examination of the facilities, provide a mobilization plan and accept the conditions present on the site. The contractor's surveyor shall be a registered land surveyor in the State of Texas and provide to the architect as required his license number and list of client references.
   2. The contractor shall provide field engineering which includes construction layout and construction surveying as often as required to construct the facilities in an accurate manner.
   3. The design professional shall include the requirement that it is the contractor's responsibility to protect adjacent construction as well as the work in progress at all times.

B. Execution
   1. The design professional shall prepare a section in the specifications describing the execution requirement applying to all phases of the work to be performed by the contractor. The following items are generally included as a part of the execution requirements:
      a. Pre-installation meetings
      b. Cutting and Patching: Specifications shall require the contractor to execute, when required, cutting and patching to complete the work, to remove and replace defective or non- conforming work, to remove samples of installed work for testing when requested, to provide openings for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
      c. Bracing and Anchoring shall be the responsibility of the contractor in such a manner as to provide a structurally sound and safe condition for the execution of the work.

C. Construction Waste Management and Disposal
   1. The design professional shall require that contractor keep the site clean and free accumulation of waste materials, debris, and rubbish with particular attention to the items listed below:
      a. Remove debris and rubbish from pipe chases, crawl spaces, closed or remote spaces prior to enclosing the space.
      b. Contractor shall broom and vacuum clean interior areas prior to start of surface finishing and maintain the cleaning process to eliminate dust.

c. The contractor shall collect and remove waste materials, trash and rubbish from the site periodically, no less than weekly, and properly dispose of all material off-site using contractor provided dumpsters/containers. Waste materials shall not be disposed of through use of ACCD dumpsters/containers, burning or burying on site.
d. The contractor shall execute final cleaning prior to final project assessment. This process includes thorough cleaning of interior surfaces including glass, walls and floors and leaving all work in a sanitary condition.
e. Final cleaning includes replacement of filters for operating equipment, removal of any debris from roof, gutters, downspouts and drainage systems, sweep paved areas and rake-clean landscape surfaces.
f. The design professional will identify items to be salvage

D. Starting and Adjusting
1. The design professional shall require that the contractor follow manufacturer's directions in the start-up of various equipment and systems. The contractor shall be required to provide a written report indicating that each system has been properly installed and that it is functioning. If required by the specifications and/or manufacturer's recommendations, the manufacturer's representation shall be present during the start-up process.
2. All mechanical systems shall be tested, adjusted, and balanced as indicated by the specifications and/or manufacturer's recommendations.

E. Closeout Procedures
1. The design professional shall provide, in the contract documents, a complete list of all required close-out submittals and procedures for Substantial Completion and Final Completion
2. The design professional shall require, review and approve close-out submittals to be provided in an organized manner using three-ring notebooks and organized by CSI sections. Include the following items in close-out submittals:
a. List of corrected deficiencies (punch list) with sign off acceptance and date for each item on the list.
b. Maintenance contracts such as elevators and other special equipment.
c. Operation and maintenance data including preventive maintenance instructions.
d. Final site survey.
e. Bonds, warranties and extended warranties as required by the specifications.
f. Project record documents, accurately prepared and presented in a legible and reproducible manner.
g. Spare parts and "attic stock"
h. Sustainable design close-out documentation, where applicable
i. Testing and balancing reports
j. List of all contractors, subcontractors and materials, including contact name and telephone/fax numbers.
k. Releases of liens from contractor, subcontractors and material suppliers, as applicable
l. Consents of Surety to payments

F. Demonstration and Training

1. The design professional shall provide in the contract documents, a complete list of all required demonstration and training procedures. The contractor shall be required to provide the following:
   a. Instruction on the operation of all mechanical and electrical equipment.
   b. Instruction and demonstration for the operation of all landscape irrigation equipment.
   c. Instruction and demonstration for the care and upkeep of all planting and hardscape materials.
   d. Instruction and demonstration of fire suppression/sprinkler systems.
   e. Instruction and demonstration of any special equipment such as theatrical, laboratory, audiovisual and telecommunication equipment.
   f. The design professional shall require the contractor to provide in his close out documents a sign-in roster with legible signatures of each attendee, the date and time and description of the training event. An effective method for some training programs is a video record of the training session.

END OF SECTION 01 70 00

Division 02 – Existing Conditions

02 20 00 Assessments
02 30 00 Subsurface Investigations
02 40 00 Demolition and Structure Moving
02 50 00 Site Remediation
02 60 00 Contaminated Site Material Removal
02 70 00 Water Remediation
02 80 00 Facility Remediation

Division 02 – Existing Conditions

SECTION 02 20 00 – ASSESMENTS

PART 1 - General

A. This standard provides general guidance concerning the identification and assessment of existing conditions within campus sites as well as existing buildings, building systems and infrastructure, where applicable.

These Alamo Community College Design and Construction Standards apply to all campuses, each with varying site conditions, infrastructure systems and building conditions.

This section addresses the essential documents, reports and findings that the designer will need to provide (or notify ACCD to provide) for timely decisions through the design phases of project development.

B. Quality Control

1. Additional costs encountered during project construction phases may be avoided or minimized if adequate information is obtained during the programming, program definition, budgeting and design processes. This allows value engineering options to be considered and decisions reached initially rather than late in the program where construction and budgets will be adversely affected.

PART 2 - Assessments

A. The design professional hired by ACCD shall have a contract in place with ACCD and a clear Scope of Work that has been reviewed as part of a work-session with ACCD prior to commencing work.

It is the design professional's responsibility (as established in their contract for services) to obtain from ACCD all necessary documents needed for the development of the project, which includes:

1. Site surveys of the campus or other appropriate areas being developed.
2. Boundary survey markers to anchor the location of the project.
3. Measured drawings as required where renovation projects are being addressed.
4. Movement, vibration, and acoustical assessments, as may be required under specific conditions.
5. Traffic assessments as required by code authority.
6. Accessibility assessments
7. Natural environment assessment
8. Trans-boundary and global environmental aspects
9. Applicable soil analyses
10. Building materials on existing projects
11. Waterproofing and roofing investigations as may be appropriate.
12. Hazardous material assessments such as asbestos, lead, PVC and biological as well as shall be considered.

13. Masonry testing
14. Historical data

END OF SECTION 02 20 00

Division 02 – Existing Conditions

SECTION 02 30 00 – SUBSURFACE INVESTIGATION

PART 1 - Subsurface Investigation

A. It is the design professional's responsibility (as established in their contract for services) to obtain from ACCD the following:
   1. Geotechnical investigations including subsurface drilling and sampling and material testing.
   2. Verify that the laboratory providing geotechnical investigations will also provide materials testing

END OF SECTION 02 30 00

Division 02 – Existing Conditions

SECTION 02 40 00 – DEMOLITION AND STRUCTURE MOVING

PART 1 - Demolition and Structure Moving

1. Define selective site demolition to provide removal of pavement, utility lines railroad tracks and other site appurtenances.
2. Define demolition of structures following safety and code compliance requirements.
3. Provide careful instructions and obtain required permits for historic building and site demolition, including removal and salvage of historic materials.
4. Where moving a structure is involved, determine code requirements, special permits, and precautions required.

END OF SECTION 02 40 00

SECTION 02 50 00 – SITE REMEDIATION

PART 1 - General

1.1 In cases where new properties are acquired or existing buildings are substantially renovated or demolished, attention will be directed to considerations as follows:

A. Contamination
   1. Physical decontamination.
   2. Chemical decontamination.
   3. Thermal decontamination.
   4. Biological decontamination.
   5. Owner / Consultant Agreement

B. Soil Stabilization
   1. Site containment as may be required
   2. Sinkhole remediation including deep sand pits, caves etc.

END OF SECTION 02 50 00

Division 02 – Existing Conditions

SECTION 02 60 00 – CONTAMINATED SITE MATERIAL REMOVAL

PART 1 - Contaminated Site Material Removal

1.1 In cases where contaminated materials are found, the design professional shall alert ACCD and provide recommendations for engaging properly licensed technical personnel for removal and disposal of contaminated soils and hazardous waste, underground storage tank removal and landfill storage.

END OF SECTION 02 60 00

SECTION 02 70 00 – WATER REMEDIATION

PART 1 - Overview

A. In cases where contaminated ground water may be present from chemical, biological, or electrolysis contamination, the design professional shall alert ACCD and provide recommendations for engaging properly licensed technical personnel.

END OF SECTION 02 70 00

Division 02 – Existing Conditions

SECTION 02 80 00 – FACILITY REMEDIATION

PART 1 - Facility Remediation

A. In cases where contaminated materials are found, the design professional shall alert ACCD and provide recommendations for engaging properly licensed technical personnel for removal and disposal of contaminated materials such as asbestos, lead, mold and polycholoorinatedbiphenyl.

This section addresses all forms of assessment remediation; however, the most important duty of the design professional in treating existing conditions is to use a standard of care sufficient to determine the forensics of the project to permit a thorough explanation of conditions and solutions to the bidding community required as part of the project.

Where forensic demolition and repair is required in order to establish the project scope of the work, the design professional shall contact and receive permission from ACCD to provide these technical services as a part of the facility investigation.

END OF SECTION 02 80 00

Division 03 – Concrete

03 00 00 Concrete General Information

Division 03 – Concrete

SECTION 03 00 00 – CONCRETE GENERAL INFORMATION

PART 1 - General

1.1 Reference Standards

A. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete; American Concrete Institute International.

B. ACI 301 – Specifications for Structural Concrete to Institute International.

C. ACI 302.1R – Guide for Concrete Floor and Slab Construction; American Concrete Institute International.

D. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International.

E. ACI 305.1 – Specification for Hot Weather Concreting; American Concrete Institute International.

F. ACI 306R – Guide to Cold Weather Concreting; American Concrete Institute International.

G. ACI 308R – Guide to External Curing of Concrete; American Concrete Institute International.

H. ACI 318 – Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International.

I. ASTM A 615/A 615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2001b. ASTM C 33/C 33M – Standard Specification for Concrete Aggregates. ASTM C 39/C 39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

J. ASTM C 94/C 94M – Standard Specification for Ready-Mixed Concrete.

K. ASTM C 143/C 143M – Standard Test Method for Slump of Hydraulic – Cement Concrete.

L. ASTM C 150/C 150M– Standard Specification for Portland Cement. ASTM C 173/C 173M – Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

M. ASTM C 309 – Standard Specification for Liquid Membrane – Forming Compounds for Curing Concrete.

N. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

O. ASTM C 1059/ C 1059M– Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

P. ASTM C 1107/ C 1107– Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

Q. ACI SP-66 – ACI Detailing Manual; American Concrete Institute International.

R. ASTM A 1064/ A 1064M – Standard Specification for Carbon-Steel Wire Reinforcement, Plain and Deformed, for Concrete.

S. ASTM A 884/A 884M – Standard Specification for Epoxy- Coated Steel Wire and Welded Wire Fabric Reinforcement. CRSI (DA4) – Manual of Standard Practice; Concrete Reinforcing Steel Institute

T. TXDOT – Texas Department of Transportation.

1.2 Quality Control

A. New Construction

1. In addition to good concrete design practices, the following are specific design criteria: Concrete compressive strength shall be as required, but not less than 3,000 psi at 28 days.
2. Provide for differential movement and provide waterstops. Where the bottom of the structure is below the water table or exposed to ground water.
3. Provide a waterproofed sleeve and/or curb at all floor slab penetrations.
4. Provide all slabs on grade with a below slab gravel capillary break and a foundation ground water collection and drainage system. Provide expansion or contraction joints at periodic intervals and at all changes in concrete section to offset member restraint. All shall be continuous through the breadth and depth of the member. Provide at all exposed slab on grade and other thin wall sections at 30 feet or less, minimum.
5. Provide keyways at all construction joints and provide continuous waterstops at all joints exposed to weather or ground water.
6. Beams and girders shall be uniform in size and spacing.
7. Column cross section shall be constant for two stories, minimum. Change column cross section with an inside face setback.
8. Dimensions of columns and beam sides shall be in multiplies of 2 inches.
9. Slope the top of all exposed concrete surfaces and provide cast-in drips at cantilevered leading edges.
10. Clear span requirements may require pre or post tensioning of long span members especially to continuous members. Special design attention shall be given to the long term effects of member shortening and creep cambering. Where continuity is established at the supports, weld the top only to
avoid compromising the member's gravity load=carrying capacity or design the bearing support members for full longitudinal load ductility.

B. Renovations

In addition to the above, consideration shall be taken to interface with existing structure.

1.3 Basis of Design (Floors)

A. Design Criteria
1. New laboratory, classrooms and office buildings
2. Design all floors in accordance to the following to support a live load of 100 PSF;
   a. New laboratory – 100 PSF
   b. Classroom – 100 PSF
   c. Office buildings – 100 PSF
   d. Shop area – 250 PSF
   e. Library – 125 PSF
   f. Special loading – as required
3. Do not reduce the live load in the design of the floor beams and floor girders.
4. Design the columns and footings to carry the 100 PSF floor live load, reduced in accordance with the governing building code. Do not include the equipment load in the design of columns and footings.
5. Identify when floating slab are required for acoustical isolation and review options with Project Manager.
6. Floors, General: The owner supports the use of floor flatness and levelness "F-numbers" as described in ASTM E 1155-87 and ACI 117. Flatness and levelness specified in terms of "1/8 - inch in 10 feet" or similar descriptions are difficult to enforce. Job-site quality control will be provided by a testing firm engaged and paid for by the Owner, unless otherwise determined by the Project Coordinator.

B. Floor Flatness and Levelness
1. Flatness and levelness tolerances for floors shall conform to the requirements set forth in ACI 117, "Standard Tolerances for Concrete Construction and Materials", particularly section 4.5.6 and 4.5.7. Either of the following specifications is acceptable.
   a. Face Floor Profile Numbers (F-Numbers): CONVENTIONAL, BULL-FLOATED; Flatness Ff = 15 Level Fl = 13 CONVENTIONAL STRAIGHTEDGED; Flatness Ff = 20 Level Fl = 15 FLAT; Flatness Ff = 30 Level Fl = 20 VERY FLAT; Flatness Ff = 50 Level Fl = 30
   b. 10-ft. Straightedge Method: CONVENTIONAL, BULL-FLOATED; ½ in. CONVENTIONAL, STRAIGHTEDGED; 5/16 in. FLAT; 3/16 in. VERY FLAT; 1/8 in.
2. Unless noted otherwise, slab surfaces shall conform to the following criteria:
   a. Offices, classrooms, corridors, etc.: FLAT.
   b. Warehouses, storerooms, equipment rooms: STRAIGHTEDGED.

c. Sidewalks, plazas, pavement:
BULL-FLOATED.

C. Vibration

1. Some buildings on campus contain research instrumentation that is extremely sensitive to vibration. Stiff floors with high resonance frequencies vibrate less than more flexible floors with low resonance frequencies. Short-span floors vibrate less than long-span floors. The structural engineer shall select a framing scheme as well as the size and spacing of columns to keep the floor vibrations within the criteria established in the Technical Programming Phase.

D. New Garage Structures

1. Limit the shrinkage to 0.00030 inches per inch (including all admixtures) in the concrete in garage floors and beams

E. All structures

1. Provide minimum concrete cover over reinforcing steel as follows:
Slabs:
Top bars in garage structures……2 inches Top bars in all other structures ---------- 1 inch
Bottom bars:
11 bar and smaller…..1 inch
14 and # 18 bar…….1 ½ inches

F. Post Tensioned Slabs

1. Use of port-tensioned slabs is disallowed because of inflexibility of the structure for remodeling. The tendons are difficult to locate in the field for future remodeling and penetrations are restricted. Post-tensioned slabs are acceptable for parking garages. All other proposed uses shall be discussed with Project Manager and Engineering Services.
2. Grout all post-tensioned concrete tendons.
3. Post tensioning may be considered for parking structures.

1.4 Basis of Design (Slab on Grade)

A. This section applies to the design and installation of concrete slabs on grade in buildings.

B. Design Criteria

1. Provide joints in all concrete slabs on grade.
2. Locate construction joints under partitions or on column lines.
3. Provide contraction joints on all column lines at 20’-0” maximum spacing each way in between.
4. Show on the plan the location of construction and contraction joints.

C. Floor Flatness and Levelness

1. Flatness and levelness tolerances for floors shall conform to the requirements set forth in ACI 117, "Standard Tolerances for Concrete Construction and Materials", particularly section 4.5.6 and 4.5.7. Either of the following specifications is acceptable.
   a. Face Floor Profile Numbers (F-Numbers): CONVENTIONAL, BULL-FLOATED; Flatness Ff = 15 Level Fl = 13
      CONVENTIONAL STRAIGHTEDGED;
      Flatness Ff = 20 Level Fl = 15
      FLAT; Flatness Ff = 30 Level Fl = 20 VERY FLAT;
      Flatness Ff = 50 Level Fl = 30
   b. 10-ft. Straightedge Method: CONVENTIONAL, BULL-FLOATED;
      ½ in.
      CONVENTIONAL, STRAIGHTEDGED; 5/16 in. FLAT; 3/16 in.
      VERY FLAT; 1/8 in.
2. Unless noted otherwise, slab surfaces shall conform to the following criteria:
   a. Offices, classrooms, corridors, etc.: FLAT.

   b. Warehouses, storerooms, equipment rooms: STRAIGHTEDGED.
   c. Sidewalks, plazas, pavement: BULL-FLOATED.

1.5 Basis of Designs (Roofs)

A. This section applies to the design and installation of roofs.

B. Design Criteria
   1. Slope the structural roof system to accomplish the roof slopes shown in the drawings, where possible. Minimum slope of ¼ inch per foot.

C. Roof Flatness and Levelness
   1. Flatness and levelness tolerances for floors shall conform to the requirements set forth in ACI 117, "Standard Tolerances for Concrete Construction and Materials", particularly section 4.5.6 and 4.5.7. Either of the following specifications is acceptable.
      a. Face Floor Profile Numbers (F-Numbers): CONVENTIONAL, BULL-FLOATED; Flatness Ff =15 Level Fl = 13
         CONVENTIONA STRAIGHTEDGED;
         Flatness Ff = 20 Level Fl = 15
         FLAT; Flatness Ff = 30 Level Fl = 20 VERY FLAT;
         Flatness Ff = 50 Level Fl = 30

      b. 10-ft. Straightedge Method: CONVENTIONAL, BULL-FLOATED;
         ½ in.
         CONVENTIONAL, STRAIGHTEDGED; 5/16 in. FLAT; 3/16 in.
         VERY FLAT; 1/8 in.
   2. Unless noted otherwise, slab surfaces shall conform to the following criteria:

a. Offices, classrooms, corridors, etc: FLAT.
b. Warehouses, storerooms, equipment rooms: STRAIGHTEDGED.
c. Sidewalks, plazas, pavement: BULL-FLOATED.

PART 2 - Products

2.1 Materials

1. Concrete retainer blocks; no polystyrene or plastic retainer blocks.
2. Cement: ASTM Designation C-150, Type III
3. Aggregates: Clean and natural crushed Steilacoom gravels complying with ASTM Designation C-33. Maximum size: not to exceed 1/5 of the minimum concrete section or ¾ of the clear distance between reinforcing bars.
4. Reinforcing: Deformed bars shall be ASTM 615; welded wire fabric shall be ASTM 185.
5. Water: Potable quality, free from oils, acids and injurious amounts of organics or salts.
6. Concrete Admixtures
   a. All admixtures shall be justifiably cost effective and result oriented.
   b. Admixtures either accelerating or retarding set times without water reduction are unacceptable.
   c. Water reducing admixtures can be used to increase slump and workability without increasing mix water.
   d. The use of super plasticizers shall be considered to temporarily increase mix fluidity whenever strength dictated low water/cement ratios interfere with successful placement and consolidation. Applications include pumped concrete placement and in thin section construction where shrinkage must be minimized.
   e. Specify air entrainment admixtures for all slabs exposed to weather. Use with high-early strength type III concrete is unacceptable. Reduce mix water by approximately one gallon per sack of cement.
   f. Fly ash is acceptable in mix quantities maximum of 20% of the weight of the concrete.
7. Sealers: The purpose of sealers is to protect exterior concrete from damage by water and to protect the window glazing from chemical leeching of the concrete.
8. Sand: Conform to the requirements of ASTM C 33.
9. Reinforcing Steel: Conform to the requirements of ASTM A 615, Grade 60.

PART 3 - Execution

1. Cure concrete slabs using liquid membrane-forming curing compound.
2. Do not use curing compounds on surfaces that are to receive additional concrete, paint or tile, or other surface, unless it has been demonstrated that the membrane-curing compound can serve as a base for the later application.
3. If the curing compound hinders positive bond, remove it (by sandblasting, etc.) after a 7-day curing period, or cure the concrete using water curing or by sealing with moisture retaining cover.

4. Maintain the temperature of the concrete at 50 degrees F or above for at least 7 days.
5. 90F˚max concrete temperature
6. 40 F˚and rising during placement
7. Forms shall be removed at such time and manner to guarantee the safety of the structure. Primary supports for elevated slabs shall not be removed before 28 days in the case of regular concrete usage. Other mix ingredients may affect this time and any primary shoring removal shall be verified by break strength tests of at least two job cured cylinders. Equivalent strength of fly ash (pozzalamic) concrete may require up to 58 days to cure properly.
8. Number of sampling core from specifications.

END OF SECTION 03 00 00

Division 04 – Masonry

04 22 00 Concrete Unit Masonry

SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - General

1.1 Reference Standards

A. Masonry Association

B. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures and Companion Commentaries.

C. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

D. ASTM A123/A 123M – Standard specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.

E. ASTM A653/A 53M - Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.

F. ASTM A580/A 580M- Standard Specification for Stainless Steel Wire.

G. ASTM A615 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.

H. ASTM B370 – Standard Specification for Copper Sheet and Strip for Building Construction.

I. ASTM C55 - Standard Specification for Concrete Building Brick.

J. ASTM C90 - Load-Bearing Concrete Masonry Units.

K. ASTM C216 - Facing Brick (Solid Masonry Units Made from Clay or Shale).

L. ASTM C652 - Hollow Brick (Hollow Masonry Units Made from Clay or Shale).

M. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

N. ACI 530.1/ASCE 6/TMS 602- Hot Weather and Cold Weather Masonry Construction Requirements.

1.2 Quality Control

A. New Construction
   1. Coordinate type of masonry, i.e., drainage wall or barrier wall, with building structural system.
   2. Consider vapor drive and air movement in design of exterior walls.

3. Consider material movement and deferential movements due to forces of temperature, wind, water and earthquake.
4. Consider potential damage to brick when used below grade.
5. Consider construction quality control when selecting masonry systems.
6. Maximum 30' for control.

B. Renovations
1. Evaluation of existing masonry structures shall be in accordance with the International Existing Building Code. Testing will be required.

1.3 Construction Submittals

A. The following minimum submittals are required from the Contractor:
1. Samples for appearance and conformance to specifications
2. Technical data
3. Wall elevations for placement of supporting steel, flashing, wall ties. Survey of wall plumbness. Show relationships between materials and openings.
4. Details showing fabrication of built-up elements, i.e., flashing and ledgers
5. Work plan, foul-weather procedures

1.4 Quality Assurance

A. The following general quality assurance measures apply:
1. Full-time inspection of all masonry work by independent forces, when required.
Mock-up is required for large projects; shall not be part of
the work; may be used to train installers. Work must be approved prior to working on the building. Use same sequencing as proposed for the building.

PART 2 - Products

2.1 Materials

A. Concrete Masonry
1. Hollow Load Bearing Block Units (CMU): ASTM C90, Type 1 – Moisture Controlled; normal weight.
Solid Load-Bearing Block Units (CMU): ASTM C90, Type I – Moisture Controlled; normal weight.
Size and Shape: Refer to plan for block sizes. Provide special units for 90 degree corners, bond beams, lintels, coved base, and bullnosed corners.

B. Reinforcement and Anchorage

1. Single Wythe Joint Reinforcement: Truss or Ladder type; steel wire, hot dip galvanized to ASTM A641 after fabrication, cold drawn steel wire conforming to ASTM A82, stainless steel conforming to ASTM A580 Type 304, 3/16 inch side rods with cross ties.
2. Reinforcing Steel: specified in Section 03 00 00.

C. Mortar and Grout
1. Mortar and Grout: Type S

D. Accessories
1. Preformed Control Joints: Rubber, Neoprene, Polyvinyl chloride material. Provide with corner and tee accessories, heat or cement fused joints.
2. Joint Filler: Closed cell polyvinyl chloride, polyethylene, polyurethane rubber; oversized 50 percent to joint width, self-expanding.
3. Weep/ Vent: Free- draining mesh
4. Cavity Drainage Material: Free- drainage polymer strand mesh.

PART 3 - Execution

3.1 Work shall conform to industry standards and meet the following:

A. Tolerances
1. Continuously cover top of wall to prevent saturation of wall.
2. Maximum Variation from Unit to Adjacent Unit: 1/32 inch.
3. Maximum Variation from Plane of Wall: ¼ inch in 10 ft. and
4. ½ inch in 20 ft or more.
5. Maximum Variation from Plumb: ¼ inch per story non- cumulative; ½ inch in two stories or more.
6. Maximum Variation from Level Coursing: 1/8 inch in 3 ft. and ¼ inch in 10 ft; ½ inch in 30 ft.
7. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

B. Cleaning
1. Clean work
2. Remove excess mortar and mortar smears as work progresses.
3. Replace defective mortar. Match adjacent work.
4. Clean soiled surfaces with cleaning solution.
5. Use non-metallic tools in cleaning operations.

C. Protection of Finished Work
1. Protect finished work.
2. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION 04 22 00

Division 05 – Metals

05 00 00 Metals

Division 05 – Metals

SECTION 05 00 00 – METALS

PART 1 - General

1.1 Reference Standards

A. AISC – ASD Manual of Steel Construction or LRFD Manual of Steel on Construction; American Institute of Steel Construction, Inc.

B. AISC S303 – Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel construction, Inc.

C. AISC S348 – Specification for Structural Joints Using ASTM A325 or A490 Bolts.

D. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.

E. ASTM A 53/A 53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

F. ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.

G. ASTM A 153/A 153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

H. ASTM A 307 – Standard Specification for Carbon Steel Bolts and Studs and Threaded Rod 60,000 PSI Tensile Strength.

I. ASTM F325/ F3125M – Standard Specification for High-Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 Mpa) and150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

J. ASTM A 501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

K. ASTM A 514/A 514M – Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.

L. ASTM A 563 – Standard Specification for Carbon and Alloy Steel Nuts.

M. ASTM A 563M – Standard Specification for Carbon and Alloy Steel Nuts (Metric).

N. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

O. ASTM A 1011/A 1011M – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and Ultra-High-Strength Low-Alloy with Improved Formability.

P. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic -Cement Grout (Nonshrink).

Q. ASTM E 94 – Standard Guide for Radiographic Examination.

R. ASTM E 164 – Standard Practice for Ultrasonic Contact Examination of Weldments.

S. ASTM F 436/ASTM F436M– Standard Specification for Hardened Steel Washers. AWS A2.4 – Standard Symbols for Welding, Brazing, Inch and Metric Dimensions, and Nondestructive Examination; American Welding Society.

T. AWS D1.1 – Structural Welding Code –Steel; American Welding Society.

U. SJI (SPEC) –Standard Specifications and Weight Tables for Steel Joists and Joist Girders; Steel Joist Institute.

V. SJI Technical Digest No. 9 – Handling and Erection of Steel Joists and Joist Girders; Steel Joist Institute.

W. SSPC – Paint 25.1 – Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over hand Cleaned Steel; Society for Protective Coatings.

X. SSPC-SP2 – Hand Tool Cleaning; Society for Protective Coatings.

Y. UL (FRD) – Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.2 Quality Control

A. New Construction
1. Structural steel strength shall not be less than 36 ksi.
2. Provide expansion joints at periodic intervals.
3. Beams and girders shall be uniform size and spacing.
4. Column cross section shall be consent for two stories minimum.
5. Structural Steel Lintels and shelf Angles – Lintels and shelf angles provided for support of masonry veneers exposed to weather must comply with the following requirements: Units must be hot-dip galvanized after fabrication.
6. Units are not required to, but may be, stainless steel.
7. Leg thickness must be sized for structural loads, but not less than 3/8-inch thick.
8. Metal Roof Deck – all metal roof deck must be hot-dip galvanized (ASTM A 525 G60 coating.)

B. Renovations
1. In addition to the above, consideration shall be taken to interface with existing structure.

1.3 Codes and Standards

A. In addition to complying with all pertinent codes and regulations, structural steel shall comply with the following:
   1. Unless noted otherwise, shall meet the requirements of the "Manual of Steel Construction, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" as amended to date and the "Code of Standard Practice" latest edition as adopted by the American Institute of Steel Construction.
   2. "Code for Welding in Building Construction" of the American Welding Society.
   3. "Specifications for Architecturally Exposed Structural Steel" of the American Institute of Steel Construction.

1.4 Basis of Design (Floors)

A. This section applies to the design and installation of elevated steel floors.

B. New laboratory, classrooms and office buildings
   1. Design all floors in accordance to the following to support a live load of 100 PSF.
      a. New laboratory – 100 PSF
      b. Classroom – 100 PSF
      c. Office buildings – 100 PSF
   2. Design the columns and footings to carry the 100 PSF floor live load, reduced in accordance with the governing building code. Do not include the equipment load in the design of columns and footings.

C. Floor Flatness and Levelness
   1. Flatness and levelness tolerances for floors shall conform to the requirements set forth in ACI 117, "Standard Tolerances for Concrete Construction and Materials", particularly section 4.5.6 and 4.5.7. Either of the following specifications is acceptable.
      a. Face Floor Profile Numbers (F-Numbers): CONVENTIONAL, BULL-FLOATED; Flatness Ff = 15 Level Fl = 13
         CONVENTIONAL STRAIGHTEDGED;
         Flatness Ff = 20 Level Fl = 15
         FLAT; Flatness Ff = 30 Level Fl = 20 VERY FLAT;
         Flatness Ff = 50 Level Fl = 30
      b. 10-ft. Straightedge Method: CONVENTIONAL, BULL-FLOATED; ½ in.
         CONVENTIONAL, STRAIGHTEDGED; 5/16 in.
         FLAT; 3/16 in. VERY FLAT; 1/8 in.
   2. Unless noted otherwise, slab surfaces shall conform to the following criteria:
      a. Offices, classrooms, corridors, etc.: FLAT.
      b. Warehouses, storerooms, equipment rooms: STRAIGHTEDGED.
      c. Sidewalks, plazas, pavement: BULL-FLOATED.

D. Vibration

1. Some buildings on campus contain research instrumentation that is extremely sensitive to vibration. Stiff floors with high resonance frequencies vibrate less than more flexible floor with low resonance frequencies. Short-span floors vibrate less than long-span floors. The structural engineer shall select a framing scheme as well as the size and spacing of columns to keep the floor vibrations within the criteria established in the Technical Programming Phase.

1.5 Basis of Design (Roofs)

A. This section applies to the design and installation of roofs.

B. Design Criteria
1. Slope the structural roof system to accomplish the roof slopes shown in the drawings. Minimum slope of ¼ inch per foot.
2. Specify the tolerance for roof surfaces to be within 1/8 inch in 10 feet, and the top of steel elevation at each column to be within 1/8 inch of the elevation shown in the drawings.

C. Qualifications of Suppliers and Personnel
1. The steel fabricator shall have not less than five years continuous experience in the fabrication of structural steel and shall have AISC certification. If no certification is in place, fabricator shall engage in a special inspection process.
2. The steel erector shall have not less than five years continuous experience in the erection of structural steel.

PART 2 - Products

2.1 Acceptable Manufacturers

A. Wheeling Corrugating Company or Vulcraft Division of Nucor. Substitutions: Items of same function and performance are acceptable if product data is submitted and approved.

2.2 Materials

A. Structural Steel and Plates
1. Steel shapes and plates shall meet at a minimum requirements of ASTM A-36, Fy =36 KSI.

B. Rectangular Tubing
1. Rectangular tubing shall meet the requirements of ASTM A-500, Grade B, Fy =46 KSI.

C. Circular Steel Pipe
1. Steel pipe shall meet the requirements of ASTM A-501 or ASTM A- 53, Type E or S, Grade B.

D. Bolts and Nuts
   1. High strength bolts: Use high strength bearing type bolts conforming to ASTM A-325 for all bolted connections unless otherwise indicated on the Drawings.
   2. Make bolt holes 1/16 inch larger than nominal bolt diameter.
   3. All bolts shall have threads excluded from the shear plane.

E. Headed Concrete Anchors
   1. ASTM A496, Installation AWS 01.1.

F. Joists
   1. Steel used in manufacturers of joists shall meet the requirements of the applicable Steel Joist Institute specifications.

G. Paint
   1. All steel joists and accessories shall receive one shop coat of paint meeting the requirements of the Steel Joist Institute Specifications.
      Where joists are exposed to view, the shop coat shall be Zinc Chromate or Red Oxide.
      Steel to be fireproofed shall be left bare or primed in accordance with fireproofing manufacturers.

PART 3 - Execution

3.1 Preparation

A. Fabricate all structural steel in strict accordance with approved Shop Drawings and the referenced standards.

3.2 Protection / Cleaning

A. Shop Cleaning and Priming
   1. Shop paint all structural steel one coat of primers, with the exception of:
   2. Steel to be encased in concrete.
   3. Surfaces to be field welded with full penetration groove welds or fillet welds.
   4. Surfaces at welds smaller than (b) may be prepared by abrasive paint removal in the field. Touch-up with same paint as used for original shop primer coat.
   5. Steel to be fireproofed shall be left bare or primed in accordance with fireproofing manufacturers.

END OF SECTION 05 00 00

Division 06 – Wood, Plastics, and Composites

06	10	00	Rough Carpentry
06	40	23	Interior Architectural Woodwork
06	61	16	Solid Surface Fabrication

Division 06 – Wood, Plastics, and Composites

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - General

1.1 Quality Control

A. Typically, ACCD does not use wood framing. Owner approval is required.

B. Insect control
   1. All older campus buildings should be thoroughly checked for termite and specifications should address treatment measures required if termites are found during renovation.
   2. New building should have slab treated for termites.
      All lumber used in ACCD buildings to be fire treated/retardant.

PART 2 - Products

2.1 Materials
   1. Contractor is required to provide UL label for fire retardant material
   2. Contractor is required to provide certification for preservative treated material.
   3. Wood blocking is required for toilet partitions, TV wall brackets, door stops, cabinets, chair rail and hand rails.
   4. Drywall installation shall not proceed until blocking has passed inspection.

PART 3 - Execution

3.1 Preparation

A. Specifications shall address environmental concerns

3.2 Protection / Cleaning

A. Specifications shall address environmental concerns

END OF SECTION 06 10 00

SECTION 06 40 23 – INTERIOR ARCHITECTURAL WOODWORK

PART 1 - General

1.1 Reference Standards

A. This standard provides general guidance concerning the specific preferences of Alamo Community College for fine shop fabricated woodwork, requiring expert craftsmanship and joinery.

Alamo Community College recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for ACCD projects.

Refer to AWI "Custom" grade.

1.2 Quality Control

A. Types of wood in specific areas
1. In remodeling work, match existing. For new construction where there is no existing to match, use AWI "Custom" grade as the guideline.

B. Cabinet and Shelving Material Selection
1. For cabinet carcass material selection and typical storage shelving fixed or adjustable, in no instance shall particleboard be used. Refer to AWI "custom" grade for preferred guidelines.

C. Visible Connections
1. Refer to AWI "Custom" grade guidelines.

1.3 Materials

A. Types of wood and finish to be specified.
1. Northwest Vista – Oak and Maple finish
2. St. Phillips College – Birch and Oak
3. Southwest Campus – Birch and Oak
4. San Antonio College – Birch and Oak

B. Color of Paint/Stain
1. The preferred finish is light in lieu of dark. Match existing for renovations.

C. Plastic Laminate

1. Refer to AWI "Custom" grade guidelines. Installation shall be only on horizontal surfaces and countertop splashes. Plastic laminate shall not be utilized for facings on cabinet doors and drawers without prior approval. Plastic laminate countertops to have a bullnose edge. Substrate material for countertops to be ¾" plywood or M.D.F. board. Installation where any off gassing will occur is not allowable in certain controlled environment. Contact the ACCD project representative for confirmation of these areas and for chemical resistant laminate requirements and locations.

D. Plywood Shelving

1. Refer to AWI "Custom" grade guidelines. Shelving to be ¾" with a typical 3'-0" span. In areas other than janitorial, finish shall be a clear coating rather than solid color paint or plastic laminate.
   Coating shall be polyurethane or lacquer type. Painted coatings may be utilized on shelving in janitorial areas.

E. Wood Chair Rails

Refer to AWI "Custom" grade guidelines. Chair rails to be stained wood. Refer to educational standards for locations required.

1. Hinges to be rated for heavy duty use, self-closing with magnetic holds.
2. Pulls to meet ADA requirements.
3. Drawer Glides to be KV.
4. Coordinate Lock location with ACCD project representative.

F. Cabinet Hardware

1. Review all cabinet hardware proposals with ACCD whether exposed or hidden installation.

G. Pre-finished Woodwork/In-field Finish

1. Provide pre-finished woodwork in any instance where this can be accomplished. Where in-field finish must be performed, coordinate environmental concerns, ventilation requirements, shutdowns, etc. with ACCD.

H. Delivery of Woodwork to Project

1. Any area where woodwork is to be installed must have been satisfactorily conditioned for temperature and humidity control prior to introduction of woodwork into the space.

PART 2 - Products

2.1 Not Used.

PART 3 - Execution

3.1 Not Used.

END OF SECTION 06 40 23

SECTION 06 61 16 – SOLID SURFACE FABRICATION

PART 1 - General

1.1 Reference Standards

A. Solid Surfaces to be used on all toilet room countertops.

B. Solid Surface materials can be used as one option for toilet partitions

C. ANSI Z124.3- Plastic Lavatories

D. ASTM D 256 – Standard test Method for Determining the Izod Pendulum Impact Resistance

E. ASTM D 570- Standard Test Method for Water Absorption of Plastics.

F. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.2 Quality Control

A. Solid Surfaces to be used on all toilet room countertops.

B. Solid Surface materials can be used as one option for toilet partitions.

C. Accepted products are listed below. All other polymer products such as Marbelite are not acceptable.

1.3 Warranty

A. Ten-year warranty from date of substantial completion against defects in materials excluding damages caused by physical or chemical abuse or excessive heat.

PART 2 - Products

2.1 Manufacturers

A. Corian by Dupont

B. Wilson Solid Surface

C. Fomica Solid Surfacing by Formica

D. Avonite

E. Pionite Solid surfacing

2.2 Materials

A. Solid Polymer fabrications. Homogeneous filled acrylic meeting ANSI Z124.3 and Z124.6, Type Six, and FS WW-P- 541E/GEN. Material to be cast, filled, acrylic; not coated, laminated or of composite construction.

PART 3 - Execution

3.1 Locations

A. Faculty toilet room countertops Toilet room toilet partitions.

3.2 Installation

A. Fabrication and installation shall be by certified or approved by manufacturer.

3.3 Protection / Cleaning

A. As per manufacturer's recommendations.

END OF SECTION 06 61 16

Division 07 – Thermal and Moisture Protection

07 11 00	Dampproofing
07 13 00	Sheet Waterproofing
07 14 13	Hot Fluid- Applied Rubberized Asphalt Waterproofing
07 18 00	Traffic Coatings
07 19 00	Water Repellents
07 21 00	Thermal Insulation
07 22 00	Roof & Deck Insulation
07 26 00	Vapor Retarders
07 32 13	Clay Roof Tile
07 41 13	Metal Roof Panels
07 51 00	Built-up Bituminous Roofing
07 52 16	Modified Bituminous Membrane Roofing
07 62 00	Sheet Metal Flashing and Trim
07 84 00	Through Penetration Fire Stop Systems
07 92 00	Joint Sealants

SECTION 07 11 00 – DAMPPROOFING

PART 1 - General

1.1 This standard provides general guidance concerning the use of materials to provide resistance to moisture penetration through foundation walls and similar surfaces subject to high humidity, dampness, and direct contact with water. This section does not apply to conditions of hydrostatic pressures.

It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying site conditions.

1.2 Reference Standards

A. ASTM D41, Standard Specification for Asphalt Primer used in Roofing, Dampproofing and Waterproofing, current edition.

ASTM D1227, Standard Specification for Emulsified Asphalt used as a Protective Coating for Roofing, current edition.

NRCA NCRA Roofing and Waterproofing Manuals; National Roofing Contractors Association, current edition.

1.3 Quality Control

1. Perform work in accordance with NCRA Roofing and Waterproofing Manual Installer.
2. Qualifications; Company specializing in performing the work will demonstrate a successful five-year experience record.
3. Installation shall follow manufacturer's product recommendations.

1.4 Warranty

A. Minimum 1 year.

PART 2 - Products

2.1 Manufacturers

1. W.R. Meadows, Inc.
2. Karnak Chemical Corp.
3. Henry Company
4. Other manufacturers providing products approved as equal.

2.2 Materials

1. Bituminous Sheet Waterproofing (07 13 13)
2. Self-Adhering Sheet Waterproofing (07 13 26)
3. Elastomeric Sheet Waterproofing (07 13 53)
4. Thermoplastic Sheet Waterproofing (07 13 54)

2.3 Finishes

A. As needed.

PART 3 - Execution

3.1 Typical Location

A. Vertical and horizontal surfaces/sub surfaces

3.2 Installation

A. Sheet waterproofing shall be compatible with substrate or primer on which it is adhered.

Verify compatibility of flashing material and adhesive with waterproofing materials.

3.3 Preparation

A. Prepare substrate prior to installation in accordance with manufacturer's directions.

3.4 Protection / Cleaning

A. Protect work during construction. For below grade work use protection board and replace any board that is damaged during construction prior to backfill placement.

Other precautions shall be taken as needed.

END OF SECTION 07 11 00

SECTION 07 13 00 – SHEET WATERPROOFING

PART 1 - General

1.1 This standard provides general guidance concerning the use of materials to provide resistance to moisture penetration through foundation walls and similar surfaces subject to high humidity, dampness, and direct contact with water. This section does not apply to conditions of hydrostatic pressures.

It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying site conditions.

1.2 Reference Standards

ASTM D41, Standard Specification for Asphalt Primer used in Roofing, Dampproofing and Waterproofing, current edition.

ASTM D1227, Standard Specification for Emulsified Asphalt used as a Protective Coating for Roofing, current edition.

NRCA ML104, The NRCA Roofing and Waterproofing; National Roofing Contractors Association, current edition. Quality Control

1.3 Quality Control

1. Perform work in accordance with NRCA Roofing and Waterproofing Manual Installer.
2. Qualifications; Company specializing in performing the work will demonstrate a successful five-year experience record.
3. Installation shall follow manufacturer's product recommendations.

1.4 Warranty

Five –year warranty

PART 2 - Products

2.1 Manufacturers

1. W. R. Grace & Co.
2. W.R. Meadows, Inc.
3. Karnak Chemical Corp.

2.2 Materials

1. Bituminous Sheet Waterproofing
2. Self-Adhering Sheet Waterproofing
3. Elastomeric Sheet Waterproofing
4. Thermoplastic Sheet Waterproofing

2.3 Finishes

As needed.

PART 3 - Execution

3.1 Typical Location

Vertical and horizontal surfaces/ sub surfaces

3.2 Installation

A. Sheet waterproofing shall be compatible with substrate or primer on which it is adhered.

Verify compatibility of flashing material and adhesive with waterproofing materials.

3.3 Preparation

A. Prepare substrate prior to installation in accordance with manufacturer's directions.

3.4 Protection / Cleaning

A. Protect work during construction. For below grade work use protection board and replace any board that is damaged during construction prior to backfill placement.

Other precautions shall be taken as needed.

END OF SECTION 07 13 00

SECTION 07 14 13 – HOT FLUID- APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - General

1.1 This standard provides general guidance concerning the use of fluid waterproofing materials to provide resistance to moisture penetration through vertical and horizontal surfaces subject to high humidity, dampness, and direct contact with water. This section does not apply to conditions of hydrostatic pressures.

1.2 Reference Standards

A. AASHTO M288, Geotextile Specification for Highway Applications ASTM C578, Specification for Rigid, Cellular Polystyrene

B. Thermal Insulation

C. ASTM D41, Specification for Asphalt Primer Used in Roofing, Damproofing, and Waterproofing

D. ASTM D412, Test Methods for Vulcanized rubber and

E. Thermoplastic Elastomers – Tension

F. ASTM D624, Test Method for Tear Strength of Conventional Vulcanized rubber and Thermoplastic Elastomers

G. ASTM D1621, Test Method for compressive Properties of rigid

H. Cellular Plastics

I. ASTM D2137, Test Methods for rubber Property – Brittleness Point of Flexible Polymer and Coated Fabrics

J. ASTM D4258, Practice for Surface Cleaning Concrete for

K. Coating

L. ASTM D4259, Practice for Abrading Concrete

M. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

N. ASTMD4397, Specification for Polyethylene Sheeting for Construction, Industrial Agricultural Applications.

O. ASTM D4716, Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

P. NRCA "The NRCA Roofing and Waterproofing Manual"

1.3 Quality Control

A. Perform work in accordance with NCRA Roofing and Waterproofing Manual Installer.

B. Qualifications; Company specializing in performing the work will demonstrate a successful five-year experience record.

C. Installation shall follow manufacturer's product recommendations.

D. Qualification of Manufacturer: Minimum 10-year experience manufacturing waterproofing products similar to those required and shall certify that products proposed for use meet or exceed specified requirements and are suitable for the use intended.

1.4 Warranty

A. Five-year warranty

PART 2 - Products

2.1 Manufacturers

A. American Hydrotech, Inc.

B. Barrett Company

C. Carlisle Corporation

D. Henry

E. Tremco

F. Other manufacturers providing products approved as equal.

2.2 Materials

A. Hot Fluid Applied Rubberized Asphalt Membrane

B. Auxiliary Materials: Primer, Flashing Sheet, Sealants, Reinforcing Fabric, Separator Sheet and Protection Board

PART 3 - Execution

3.1 Typical Location

A. Prepared horizontal

3.2 Installation

A. Hot Liquid Applied waterproofing shall be compatible with substrate or primer on which it is adhered.

B. Verify compatibility of flashing material and adhesive with waterproofing materials

C. Verify acceptable moisture content of substrate.

D. Cure waterproofing in accordance with manufacturer's recommendations.

E. Protect membrane from damage during application, curing and construction periods.

3.3 Preparation

A. Prepare substrate prior to installation in accordance with manufacturer's directions.

3.4 Protection / Cleaning

A. Protect work during construction.

B. Other precautions shall be taken as needed.

END OF SECTION 07 14 13

SECTION 07 18 00 – TRAFFIC COATING

PART 1 - General

1.1 This standard provides general guidance concerning the use of materials to provide traffic coatings for pedestrian and vehicular traffic. It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying site conditions.

1.2 Reference Standards

1. ASTM C957, Standard Specification of High-Solids Content, Cold Liquid Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface
2. ASTM C1127, Standard Guide for Use of High Solids Content, Cold Liquid- Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface
3. ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
4. ASTM D4259, Standard Practice for Abrading Concrete
5. ASTM D4258, Standard Practice for Surface Concrete for Coating
6. TX DOTPavement Marking Handbook
7. TX DOT Manual of Uniform Traffic Control Devices Quality Control
8. Perform work in accordance with NCRA Roofing and Waterproofing Manual Installer.

1.3 Quality Control

A. Installation shall be by manufacturer's authorized representative who is trained and approved for installation. Mock-ups are required prior to installation to demonstrate surface preparation, joint and crack treatment, thickness, color, and standard of workmanship.

1.4 Warranty

A. Five-year warranty from date of substantial completion.

PART 2 - Products

2.1 Manufacturers

A. Carlisle Coatings and Waterproofing, Inc.

B. Dex-O-Tex/Crossfield Products Corp.

C. Tremco Inc.

D. Neoguard, Division of Jones Blair

E. Degussa Building Systems, Sonneborn Brand Products

2.2 Materials

A. Traffic coatings complying with ASTM C957.

B. Primer, epoxy or urethane recommended for substrate and conditions, as indicated.

C. Base coat, aromatic liquid urethane elastomer.

D. Intermediate coat, single or multi component aromatic liquid urethane elastomer.

E. Top coat, single or multi component aromatic liquid urethane elastomer.

F. Aggregate, uniformly graded Washed silica carbide sand.

G. Joint sealants as required.

2.3 Finishes

A. Colors as approved from the TXDOT Manual of Uniform Traffic Control Devices.

PART 3 - Execution

3.1 Typical Location

A. Horizontal surfaces, decks and roadways.

3.2 Installation

A. Substrates should be examined with installer present. Test for moisture vapor transmissions and moisture content.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface, mask adjoining surfaces, deck drains and other substrates.

B. Mechanically abrade concrete surfaces.

C. Remove all grease, oil, paint, ridges, curing compounds, laitance and other loose materials.

D. Prepare other vertical, horizontal terminations and penetrations.

3.4 Protection / Cleaning

A. Permit adequate drying/curing time.

B. Protect coatings during construction period.

END OF SECTION 07 18 00

SECTION 07 19 00 – WATER REPELLENTS

PART 1 - General

This standard provides general guidance concerning the use of water repellents for above-grade surfaces of concrete, stone, masonry and stucco. It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying site conditions

1.1 Reference Standards

A. Absorption
1. Brick, ASTM C67
2. Stone, ASTM C97
3. Concrete Unit Masonry, ASTM C140
4. Hardened Concrete ASTM C642

B. Water Vapor Transmission
1. ASTM E96

C. Permeability
1. ASTM D1653
2. Water Penetration/Leakage through Masonry
3. ASTM E514
4. Durability
5. ASTM G154

D. ChlorideIon Intrusion in Concrete
1. NCHRP Report 244, Series II Test

1.2 Quality Control
1. Installer and Workers trained by manufacturer.
2. Pre-installation conference is required.
3. Manufacturer's qualifications: 10 years in manufacturing products.
4. Provide mock-up of each product required by specification.

1.3 Warranty

A. Five-year warranty against failure of material and workmanship is required.

PART 2 - Products

2.1 Manufacturers

A. Silane Penetrating Water Repellent Clear
   1. Tnemec Company, Inc./ Deck A Pell
   2. Sonneborn Building Products, a division of ChemRex/ White Roc 10 WB
   3. Advanced Chemical Technologies, Inc./ ATS-22, ATS-100
   4. Tamms Industries, Inc./Baracade Silane 40, Baracade Silane 40 IPA

B. Siloxane Penetrating Water Repellent Clear
   1. Chemical Product Industries, Inc./CP-500W
   2. Chemprobe Coating Systems, LP/Prime A Pell H20
   3. Euclid Chemical Company/WeatherGuard
   4. Wacker Chemical Corporation/29A, 290, 1001A, 2001, SMK 1311, as applicable

2.2 Materials

A. The preferred products will be low VOC; aqueous based with no noxious odors or volatile solvents.

B. Products shall be non-yellowing.

C. Products should be resistant to oils, acids, solvents, alcohols, and salts.

D. Products containing fillers, sterates or paraffins are unacceptable.

2.3 Finishes

A. Preferred finish is clear.

PART 3 - Execution

3.1 Typical Location

A. Sealing of horizontal and vertical exterior surfaces such as brick, stone and concrete.

3.2 Installation

A. Examine all surfaces prior to applying repellent in the presence of manufacturer's representative and the approved installer.

Apply repellents in accordance with Manufacturer's printed instructions.

Apply evenly until specified coverage has been achieved.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface, mask adjoining surfaces, deck drains and other substrates.

B. Remove all grease, oil, paint, ridges, curing compounds, laitance and other loose materials.

C. Prepare other vertical, horizontal terminations and penetrations.

3.4 Protection / Cleaning

A. Protect work during construction.
   1. Permit adequate drying/curing time.
   2. Protect coatings during construction period.

END OF SECTION 07 19 00

Division 07 – Thermal and Moisture Protection

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - General

1.1 This standard provides general guidance concerning the use of thermal insulating products

It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying uses for thermal insulation depending on building types and local conditions.

1.2 Reference Standards

A. ASTM E84,Surface Burning Characteristics

B. ASTM E119 Fire resistance Ratings

C. ASTM E136 Combustion Characteristics

D. Board Insulation

E. ASTM C578, Type I: Molded-Polystyrene

F. Board Insulation

G. ASTM C4578, Type VI: Fabric -Faced Extruded Polystyrene Drainage Panels

H. ASTM C1289, Type I: Foil-Faced, Polyisocyanurate Board Insulation

I. Blanket Insulation

J. ASTM C665, Standard for Mineral-Fiber Blanket Thermal Insulation

K. ASTM C665, Type I: Glass-Fiber Blanket Thermal Insulation.

L. ASTM C665, Type III

M. Faced, Slag-Wool-Fiber/Rock-Wool-Fiber Blanket Insulation

N. Loose Insulation

O. ASTM C739 Cellulosic -Fiber Loose Fill Insulation ASTM C764 Mineral-Fiber Loose Fill Insulation

P. ASTMC549 Perlite Type, Water Repellent Granular Loose-Fill Insulation

1.3 Performance

A. Minimum standard for roof insulating systems shall be R30 for roof (average), and for walls the standard shall be R19.

1.4 Quality Control

1. No paper-faced product is allowed.
2. Adherence to substrate in accordance with manufacturer's directions.
3. Qualified installing subcontractor.

1.5 Warranty

A. One-year warranty

PART 2 - Products

2.1 Manufactures

A. Board Insulation
1. Dow Chemical
2. Owens Corning
3. Certain Teed Corporation
4. DiversiFoam products

B. Blanket Insulation
1. Certain Teed Corporation
2. Guardian Fiberglass, Inc.
3. Johns Manville
4. Fibrex Insulations
5. Owens Corning

C. Loose Insulation
1. Member Producers of Perlite, Institute
2. World Minerals, Inc.
3. Redco II
4. THERM-O-ROCK WEST, Inc.

2.2 Materials

A. Board Insulation
1. Fitted insulation boards
2. Extruded polystyrene Drainage panels

3. Molded polystyrene board insulation
4. Foil-faced polyisocyanurate board insulation
5. Glass-fiber board insulation
6. Glass-mat-Faced, glass fiber board insulation
7. Slag-Wool-Fiber board insulation

B. Blanket Insulation
1. Glass fiber blanket insulation
2. Slag-Wool-Fiber rock wool insulation

C. Loose Insulation
1. Member Producers of Perlite, Institute
2. World Minerals, Inc.
3. Redco II
4. THERM-O-ROCK WEST, Inc.

PART 3 - Execution

3.1 Typical Location

A. Ceilings, walls, underfloor, cavity walls and perimeter beams.

3.2 Installation

A. Install each type of insulation using certified, trained factory- approved subcontractors and personnel.

B. All boards and blankets shall fit tightly at each edge with proper stapling of flanges, as appropriate.

C. All boards shall be adhered to substrate with factory- recommending adhesives and anchors.

D. Place loose-fill insulation level in cavities without excessive compaction.

3.3 Preparation

A. Stuff glass fiber loose-fill insulation into miscellaneous voids and cavity spaces.

3.4 Protection / Cleaning

A. Keep all insulation products dry and protected from construction damage.

B. Refill voids formed due to construction penetrations.

END OF SECTION 07 21 00

SECTION 07 22 00 – ROOF AND DECK INSULATION

PART 1 - General

1.1 This standard provides general guidance for the use of materials to be applied to the roofing system and exterior decks over occupied spaces.

It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying roofing and deck conditions.

1.2 Reference Standards

A. ASTM C208, Cellulosic Fiber Insulating Board

B. ASTM C209, Test Methods for Cellulosic Fiber Insulating Board

C. ASTM C518, Steady-State Heat Flux Measurements and Thermal Transmission Properties

D. ASTM C726, Mineral Fiber Insulation Board

E. ASTM C728, Perlite Thermal Insulation Board

F. ASTM D481, Asphaltic Primer Used in Roofing and Waterproofing

G. ASTM D312, Asphalt Used in Roofing

H. ASTM D2822, Asphalt Roofing Cement ASTM E108 Fire Test of Roof Coverings

I. ASTM C-1289, Polyisocyanurate Board Insulation

J. ASTM C-1289-95 Perlite Polyisocyanurate Composite Board, Type II

K. NRCA "The NRCA Roofing and Waterproofing Manual"

1.3 Quality Control

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual Installer.

B. Qualifications; Company specializing in performing the work will demonstrate a successful five-year experience record.

C. Installation shall follow manufacturer's product recommendations.

D. Tapered insulation shall be designed and furnished by a company experienced in both design and installation of tapered insulation.

E. System shall conform to I90 FM Global Classification

F. Avoid roof insulation that absorbs water.

1.4 Warranty

A. Roof and deck insulation shall be a part of a two-year contractor warranty as well as a 20year manufacturer's No Dollar Limit material and labor warranty.

PART 2 - Products

A. Manufacturers
1. Honeywell
2. Apache Products Company
3. Atlas Roofing Corporation
4. Celotex Corporation
5. Atlas Roofing Manufacturing
6. Georgia Pacific
7. Owens Corning
8. R-Max, Inc.

2.2 Materials

A. Polyisocyanurate foam board with R30 value ASTM C518.

B. Perlite board, ASTM C728.

C. Factory Tapered Perlite board, ASTM 728.

D. Product installation acceptable to Roofing Manufacturer.

PART 3 - Execution

3.1 Typical Location

A. Horizontal surfaces, roofs and decks.

3.2 Installation

A. Substrates should be examined with installer present. Test for moisture vapor transmissions and moisture content.

B. Installation in accordance with manufacturer's instructions.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface.

B. Remove all grease, oil, paint, ridges, curing compounds, laitance and other loose materials.

C. Prepare other horizontal terminations and penetrations.

3.4 Protection / Cleaning

A. Protect insulation during roof and deck construction period.

END OF SECTION 07 22 00

SECTION 07 26 00 – VAPOR RETARDERS

PART 1 - General

1.1 This standard provides general guidance concerning the use of materials to be applied under concrete slab construction.

It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying construction conditions requiring vapor retardants.

1.2 Reference Standards

A. ASTM E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders used in with Earth under Concrete Slabs.

B. ASTM E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contract with Soil or Granular Fill under Concrete Slabs.

C. ASTM D1709, Standard Test Methods for Puncture Resistance ASTM E154, Standard Test Method for Water Vapor Retarders used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover.

1.3 Quality Control

A. Manufacturer's qualification: a minimum of three years documented experience in specialization in manufacturing products specified in this section.

B. Installer qualification: company specializing in installation of the work with a minimum of five years' experience.

1.4 Warranty

A. One-year contractor's warranty

PART 2 - Products

2.1 Manufacturers

A. W R Meadows, Inc., Hampshire, IL

B. Raven Industries, Sioux Falls, SD

2.2 Materials

A. Extruded 15-mil polyolefin membrane.

B. Material manufactured with ISO certified virgin resins.

C. High density polyethylene tape with pressure-sensitive adhesive.

PART 3 - Execution

3.1 Typical Location

A. Horizontal surfaces below concrete and where ground cover is used.

3.2 Installation

A. Installed with pressure-sensitive adhesive tape, minimum lap 4 inches.

B. Repair any tears or punctures prior to placement of concrete.

3.3 Preparation

A. Prepare ground condition to be free of rocks and other material that may puncture vapor retarder.

3.4 Protection / Cleaning

A. Protect vapor retarder during placement of reinforcing and concrete.

END OF SECTION 07 26 00

SECTION 07 32 13 – CLAY ROOF TILE

PART 1 - General

1.1 This standard provides general guidance concerning the use of Clay Roof Tile roofing systems.

1.2 It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying roof conditions. The use of tile roof systems applies to specific projects at Palo Alto and San Antonio College campuses.

1.3 The use of tile roofing systems for new buildings is discouraged unless these structures are a part of an existing cluster where the design intent would be compromised with a change in roofing systems. These exceptions will require approval of the ACCD Program Manager.

1.4 Reference Standards

A. ASTM C 1167
   1. Molded or Extruded-clay Roof Tile Units.

B. ASTMD 4586
   1. Type II Asphalt Roofing Cement

C. ASTM C 1311
   1. Butyl Sealant ASTM C 920, Elastomeric Sealant

D. ASTM D 312
   1. Type IV Roofing Asphalt

E. ASTM C 270
   1. Type M Natural Color Mortar

F. ASTM F 1667
   1. Roofing Nails

G. ASTM D 226
   1. Type II Roof Felt Underlayment

H. ASTM D 2626
   1. Asphalt Saturated Roof Underlayment

I. ASTM C 249
   1. Type I Roll Roofing Underlayment

J. ASTM D 1970
   1. Self-Adhering 55 mil Granular Faced Roofing Underlayment

K. ASTM D 1970
   1. Self-Adhering 40 mil Polyetheline Faced Roof Underlayment

L. Division 7
   1. Sheet Metal Flashing and Trim

M. ASTM B 749
   1. Type L51121 Vent Pipe Flashing

N. SMACNA (ASMM)
   1. Architectural Sheet Metal Manual;
   2. Sheet Metal and Air Conditioning Contractors' National Association 2003

O. RTI/WSRCA
   1. "Concrete and Clay Roof Tile Roof Design
   2. Criteria Installation Manual for Moderate Climate Regions"

P. NRCA
   1. The NRCA Roofing and Waterproofing Manual

1.5 Quality Control

A. Perform work in accordance SMACNA architectural sheet metal manual; sheet metal and standard details.

B. Provide mock-up to demonstrate size and color range.

PART 2 - Products

2.1 Manufacturers

A. Manufacturer determined by product compatibility with roofing system.
   1. Altusa/Interclay, Corp.
   2. Ameri-Clay Roof Tile
   3. Claymex Brick & Tile Co.
   4. Deleo Clay Tile
   5. D'Hanis Brick & Tile Company
   6. Gladding, McBean, Div. of Pacific Coast Building Products, Inc.

7. International Roofing Products, Inc.
8. Ludowici Roof Tile, Inc.
9. MCA Tile
10. US Tile Co.
11. Zion Tile Corp

2.2 Materials

A. Sheet metal flashings will include the use of mill-finish aluminum, copper, anodized aluminum, galvanized steel and other products compatible with adjacent roofing, window wall or other building systems.

2.3 Finishes

A. Colors as approved

B. Use care to match color and style of existing systems

PART 3 - Execution Typical Location

3.1 Roofs, canopies, copings and special details.

A. Section 07 32 13

B. Clay Roof Tiles

3.2 Installation

A. Substrates should be examined with installer present. Test for moisture vapor transmissions and moisture content. Conduct Pre- Installation Conference
   1. Underlayments
      a. Install underlayments in accordance with manufacturers recommendations in parallel courses running perpendicular with slope of roof.
      b. Stagger end laps minimum of 72” with laps a minimum of 6”.
      c. Lap edges a minimum of 3”.
      d. Terminate roof felt underlayment a minimum of 6” against chimneys, side walls, curbs and other projections.
      e. Follow NRCA details for all underlayment, valley and other flashings, nailing and self adhering when used.
   2. Wood Nailers and Battens
      a. Pressure treated wood nailers at ridges hips and rakes.

b. Beveled wood cant at eaves.
c. Wood batten strips installed horizontal at spacing required by tile manufacturer.
d. Follow NRCA details for installation of batten strips.

3. Tile Installation
   a. Maintain uniform exposure and coursing of tiles throughout roof.
   b. Install nailing and wire tying in accordance with manufacturers written instructions.
   c. Follow NRCA details for installation of batten strips.
4. Protection / Cleaning
   a. Clean and prepare substrates to produce a dust-free dry surface, mask adjoining surfaces, deck drains and other.
   b. Remove and replace broken tile units.
   c. Remove and replace broken tile units and debris from site.
   d. Clean and protect tile roofing installation during construction.

END OF SECTION 07 32 13

SECTION 07 41 13 – METAL ROOF PANELS

PART 1 - General

1.1 This standard provides general guidance concerning the use of metal roofing panels on campus buildings.

It is recognized that the Alamo Community College Design and Construction Standards will apply to all campuses, each with varying roof conditions. Metal roofs have been used throughout the District predominantly at Northwest Vista and Palo Alto Colleges.

Design architects shall establish the roofing criteria on each campus before development of the project design(s)

1.2 Reference Standards

A. American Iron & Steel Institute (AISI), Design of Cold formed Steel Structural Members

B. ASTM A 641/A 641M, Zinc Coated (Galvanized Carbon Steel Wire, latest edition.

C. ASTM A 653/A 653M, Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, latest edition.

D. ASTM A 924/A 924M, General Requirements for Steel sheet, metallic - Coated by the Hot Dip Process, latest edition.

E. ASTM C 645 , Standard Specification for Nonstructural Steel Framing members, latest edition.

F. ASTM C 920 Elastomeric Joint Sealants, latest edition

G. ASTM E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen, latest edition

H. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference, latest edition

I. ASTM E 1592 Standard Test Method for Structural Performance of sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference, latest edition.

J. SMACNA Architectural Sheet Metal Manual

K. UL Fire Resistance Directory – Underwriters Laboratories Inc., latest edition

M. UL580 Tests for Uplift Resistance of Roof Assemblies; Underwriters Laboratories, latest edition

1.3 Quality Control

A. Mock-ups are required prior to installation to demonstrate method of connection to substrate and the finish of the standing seam. Provide the following, as applicable:
   1. Roof Panel / Lock Seal
   2. Overhang Condition
   3. Ridge vent
   4. Soffit

B. Installation shall be by manufacturer's authorized representative who is trained and approved for installation.
   1. Manufacturer's Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years of documented experience.
   2. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.
   3. Installation of roof system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Texas as required by system manufacturer.
   4. Metal roofing systems shall be pitched at 3:12 or greater in accordance with NRCA standards. No metal roof systems less than 3:12 pitch will be permitted.

1.4 Warranty

A. Contractor's two-year water-tightness warranty.

Manufacturer's twenty-year water tightness warranty No Dollar Limit.

PART 2 - Products

2.1 Manufacturers

A. American Hydrotech, Inc.

B. Barrett Company

C. Carlisle Corporation

D. Henry

E. Tremco

G. Other manufacturers providing products approved as equal.

2.2 Materials

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, Type X, 5/8-inch (16-mm) thick.

B. Substrate-Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion- resistance provisions in FMG 4470.

C. Base coat, aromatic liquid urethane elastomer.

D. Intermediate coat, single or multi component aromatic liquid urethane elastomer.

E. Top coat, single or multi component aromatic liquid urethane elastomer.

F. Metallic coated sheet steel, 0.024 inch thick minimum in coil form with Kynar 500 fluoropolymer metal coating or aluminum-zinc alloy coated.

G. Specifications for standing-seam metal roofs shall require a double -lock system with fasteners and accessories as required. Formed roof panel seams shall be 1-inch minimum in height with a 12 ¾-inch on-center seam spacing.

H. Continuous ridge vent system shall be used in lieu of roof top ventilators

2.3 Finishes

A. Kynar or “Galvalume” finishes with color selection approved by owner to meet campus standards.

PART 3 - Execution

3.1 Typical Location

A. Roofs and awnings

3.2 Installation

A. Examine roof deck to ensure proper attachment to framing.

B. Inspect roof deck to verify that it is clean and smooth, free of moisture, depressions, waves or projections and properly sloped to valleys or eaves.

C. Panels should be site-formed with manufacturer's portable roll former, continuous lengths from eave to ridge or factory formed (40-foot maximum).

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface, mask adjoining surfaces, deck drains and other substrates.

B. Prepare other vertical, horizontal terminations and penetrations.

C. Assure proper connection of substrate to deck framing and completion of self-adhering sheet underlayment.

D. Install flashings and other sheet metal devices, and roof penetrations.

3.4 Protection / Cleaning

A. Protect roof materials during construction period.

B. Protect finished roof installation from damage during installation of adjacent work.

END OF SECTION 07 41 13

SECTION 07 51 00 – BUILT-UP BITUMINOUS ROOFING (ASPHALT AND COAL-TAR)

PART 1 - General

1.1 This standard provides general guidance concerning the use of built- up roofing (BUR) systems.

It is recognized that the Alamo Community College Design and Construction Standards for these systems will apply only to St. Philip's College (both campuses), Palo Alto College, and any other individual locations where asphalt bituminous roofing or coal tar pitch roofing occurs.

It is the intent that these standards apply to the repair of and additions to existing bituminous roofing systems. No additional installations of new facilities will allow the use of these systems.

1.2 Reference Standards

A. ASTM D1079 See this reference for the definition of roofing terms used in this section.

B. NRCA Roofing and Waterproofing Manual

1.3 Quality Control

A. Installation shall be in accordance with NRCA Roofing and Waterproofing Manual Installer.

B. Qualifications; Company performing the work will demonstrate a successful ten-year experience record.

C. Systems shall conform to Factory Mutual I-90 specification.

D. On roofs supporting roof equipment, install protective roof walkways, acceptable to roof manufacturer but no less than 48" wide, to and around roof equipment from any point of access. Pads shall adhere to roofing membrane.

1.4 Warranty

A. Roofing system shall be part of a two-year contractor as well as a twenty-year manufacturer's No Dollar Limit material and labor warranty.

PART 2 - Products

2.1 Manufactures

A. Hickman W P Systems, Inc. (asphalt and coal tar)

B. Honeywell Commercial Roofing Systems (asphalt and coal tar)

C. Barrett Company (asphalt)

D. Certain Teed Corporation (asphalt)

E. Koppers Industries (coal tar)

2.2 Materials

A. Base sheets, ply sheets, flashings in accordance with manufacturer's recommendations.

B. Use primer and bitumen materials consistent with adjacent roofing.

2.3 Finishes

A. Aggregate surfacing shall be water-worn gravel or crushed stone, free of sharp edges and consistent with adjacent surfaces.

PART 3 - Execution

3.1 Typical Location

A. Roofs

3.2 Installation

A. Substrates should be examined with installer and factory representative present. Test for moisture vapor transmissions and moisture content.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface.

B. Prepare other vertical, horizontal terminations and penetrations.

3.4 Protection / Cleaning

A. Protect existing roofing surface during construction period.

B. Install only the number of roofing plies that can be completed in a day.

C. Protect substrate insulation from water and damage during application of roofing.

END OF SECTION 07 51 00

SECTION 07 52 16 – MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - General

1.1 This standard provides general guidance concerning the use of modified bituminous membrane roofing systems. The ACCD standard is a two-layered modified bitumen system.

It is recognized that the Alamo Community College Design and Construction Standards for this system will apply only to all campuses where low-sloped modified bitumen new construction is permitted.

1.2 Reference Standards

A. ASTM D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing, latest

B. ASTM D312, Standard Specification for Asphalt Used in Roofing, latest edition

C. ASTM D451, Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products

D. ASTM D4586, Standard Specification for Asphalt Roof Cement, Asbestos-free, latest edition

E. ASTM D4897 Standard Specification for Asphalt-Coated Glass- Fiber Venting Base Sheet Used in Roofing, latest edition

F. FM DS 1-29, Design Wind Loads; factory Mutual Research Corporation, latest edition

G. NRCA ML104, The NRCA Roofing and Waterproofing Manual; National Roofing Contractors association; latest edition.

H. ASCE-7, Wind up lift design

1.3 Quality Control

A. Installation shall be in accordance with NRCA Roofing and Waterproofing Manual Installer.

B. Qualifications; Company performing the work will demonstrate a successful ten-year experience record and be approved by the manufacturer for the installation of their system.

C. Systems shall conform Factory Mutual -90 specification.

D. System shall conform to ASCE-7 wind loading requirements

E. Solar reflectance index not less than 78 when calculated according to ASTM 1980

F. Entire roofing system to be provided by one manufacturer

1.4 Warranty

A. Roofing system shall be part of a two-year contractor as well as a twenty-year manufacturer's No Dollar Limit material and labor warranty.

1.5 Submittals

A. Sample warranties for standard and special warranties

B. Shop drawings

C. Product data for each type of product

PART 2 - Products

2.1 Manufacturers

A. CertainTeed Corporation

B. GAF

C. Johns Manville

D. Garland Company

E. Siplast Company

2.2 Materials

A. Asphalt primer, V.O.C. compliant.

B. Asphalt roofing mastic, V.O.C. compliant

C. Asphalt: ASTM Specification D312, Type IV.

D. Fiberglass felt

E. Modified bitumen base sheet membrane: SBS, ASTM D 4601 Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides

F. Glass-Fiber Base-Ply Sheet: ASTM D 2178, Type VI, asphalt-impregnated, glass-fiber felt.

G. SBS-Modified Asphalt Roofing Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers)

H. SBS-Modified Asphalt Granule-Surface Roofing Cap Sheet: ASTM D 6163, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) granule surfaced; suitable for application method specified.

I. Base Flashing Sheet Materials: SBS-Modified Asphalt Granule-Surfaced Flashing Sheet: ASTM D 6163, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers); granule surfaced; suitable for application method specified, color to match roofing sheet.

J. Roof insulation

K. Vapor Retarder: Polyethylene Film, Laminated Sheet, Glass- Fiber- Felt

2.3 Finishes

A. Second ply shall be a factory-installed granular finished with approved color.

PART 3 - Execution

3.1 Typical Location

A. Roofs

3.2 Installation

A. Substrates should be examined with installer and factory representative present.

B. Contractor's roofing conference prior to installation is mandatory.

C. Test for moisture vapor transmissions and moisture content.

D. On roofs supporting roof equipment, install protective roof walkways, acceptable to roof manufacturer but no less than 48" wide, to and around roof equipment from any point of access. Pads shall adhere to roofing membrane.

E. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
   1. Adhering Method: T (torched).
   2. Base Sheet: One.
   3. Number of Glass-Fiber Base-Ply Sheets: One.
   4. Number of Modified Asphalt Sheets: Two.
   5. Surfacing Type: P (protected).

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface.

B. Prepare other vertical, horizontal terminations and penetrations.

3.4 Protection / Cleaning

A. Protect existing roofing surface during construction period.

B. Install only the number of roofing plies that can be completed in a day.

C. Protect substrate insulation from water and damage during application of roofing.

END OF SECTION 07 52 16

SECTION 07 62 00 – FLASHING AND TRIM

PART 1 - General

1.1 This standard provides general guidance concerning the use of fluid waterproofing materials to provide resistance to moisture penetration through vertical and horizontal surfaces subject to high humidity, dampness, and direct contact with water. This section does not apply to conditions of hydrostatic pressures.

1.2 Reference Standards

A. AAMA 611, 2603, 2604 Voluntary Specifications for Anodized and Organic Products and Coatings: 1998 and 2002.

B. ASTM A 653/A 653M

C. Standard Specification for Steel Sheet, Zinc- Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A 792/A 792M

E. Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process, latest issue

F. ASTM B 209, Standard Specification for Aluminum and

G. Aluminum-Alloy Sheet and Plate

H. ASTM B 209M Standard Specification for Aluminum and

I. Aluminum-Ally sheet and Plate.

J. ASTM D 4479 Standard Speciation for Asphalt Roof Coatings –

K. Asbestos Free

L. ASTM D 4586 Standard Specification for Asphalt Roof Cement – Asbestos Free

M. SMACNA (ASMM)

N. Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association"

1.3 Quality Control

A. Perform work in accordance SMACNA architectural sheet metal manual; sheet metal and standard details with special attention to overlaps and sealants.

1.4 Warranty

A. One-year contractor's warranty, unless part of a roofing assembly in which case, the roofing assembly warranty governs.

PART 2 - Products

2.1 Manufacturers

A. American Hydrotech, Inc.

B. Barrett Company

C. Carlisle Corporation

D. Henry

E. Tremco

F. Other manufacturers providing products approved as equal.

2.2 Materials

A. Sheet metal flashings will include the use of mill-finish aluminum, anodized aluminum, galvanized steel and other products compatible with adjacent roofing, window wall or other building systems.

2.3 Finishes

A. Color as approved

PART 3 - Execution

3.1 Typical Location

A. Horizontal surfaces, decks and roadways.

3.2 Installation

A. Substrates should be examined with installer present. Test for moisture vapor transmissions and moisture content.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface, mask adjoining surfaces, deck drains and other substrates.

B. Mechanically abrade concrete surfaces.

C. Remove all grease, oil, paint, ridges, curing compounds, laitance and other loose materials.

D. Prepare other vertical, horizontal terminations and penetrations.

3.4 Protection / Cleaning

A. Permit adequate drying/curing time.

B. Protect coatings during construction period.

END OF SECTION 07 62 00

SECTION 07 84 00 – TROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - General

1.1 This standard provides general guidance concerning the use of Through-Penetration Firestop systems in the design of educational facilities requiring firestop as a part of the rated building system protection. Designer will provide fire stop system schedule.

1.2 Reference Standards

A. ASTM E 814, Standard Test Method for Fire Tests of Through- Penetration Fire Stops. UL Fire Resistance Directory

1.3 Quality Control

A. Installation shall be in accordance with ASTM Fire Tests Report.

B. Qualifications; Company performing the work will demonstrate a successful five-year experience record in the installation of firestopping systems.

1.4 Warranty

A. One year-year contractor's Warranty.

PART 2 - Products

2.1 Materials and Manufacturers

A. Elastomeric Silicone Firestopping. A/D Fire Protection Systems, 3M Fire Protection Products, Specified Technologies, Inc., Hilti, Inc.

B. Foam Firestopping 3M Fire Protection Products, Specified Technologies, Inc.

C. Fibered Compound Firestopping. A/D Fire Protection Systems, USG Corporation

D. Fiber Packing Material A/D Fire Protection Systems, USG Corporation

E. Firestop Devices, 3M Fire Protection Products, Specified Technologies, Inc., Grace Construction Products

F. Intumescent Putty, 3M Fire Protection Products, Specified Technologies, Inc., Grace Construction Products

G. Firestop Pillows Specified Technologies, Inc., Grace Construction Products, Nelson Firestop Products

H. Fire Brick Hilti, Inc.

I. Primers, Sleeves, Forms and Accessories (type required for tested assembly design)

PART 3 - Execution

3.1 Typical Location

A. All areas subject to area separation, changes in protection requirements and code interpretations

3.2 Installation

A. Install materials in compliance with fire test report completely closing openings.

B. Installation shall be in compliance with manufacturer's recommendations.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface free from grease, oil or loose materials.

B. Remove incompatible materials which may affect bond.

C. Install backing materials to arrest liquid material leakage.

3.4 Protection / Cleaning

A. Clean off excess materials as the work progresses

B. Provide final protection to insure systems are without damage until project completion

END OF SECTION 07 84 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - General

1.1 This standard provides general guidance concerning the use of sealants, joint backing and pre-compressed sealers.

1.2 Reference Standards

A. ASTM C 834, Standard Specification for Latex Sealants. ASTM.C

B. 919, Standard Practice for Use of Sealants in Acoustical Applications.

C. ASTM.C 920, Standard Specification for Elastomeric Joint Sealants

D. ASTM.C 1193, Standard Guide for Use of Joint Sealants ASTM.C 1667 Standard Specification for Flexible Cellular Materials—Vinyl Chloride Polymers and Copolymers

1.3 Quality Control

A. Maintain copy of each reference document covering installation requirements on site.

B. Manufacturer qualifications:

C. Company specializing in manufacturing the products specified in this section for a three-year period of documented experience.

D. Applicator Qualifications:

E. Company specializing in performing the work specified in this section for a five-year period of documented experience.

F. Mock up: Install in assemblies required by other sections. Use Specified materials and installation method.

1.4 Warranty

A. One year-year contractor's Warranty.

PART 2 - Products

2.1 Materials

A. Sealants

1. GPX General Purpose Exterior Sealant ASTM C 920, Grade NS Class 25, Uses M, G and A-Single component
2. Type XEJFMExterior Expansion Joint Sealer Pre- compressed foam sealer, urethane with water repellant.
3. Type LAP Exterior Metal Lap Joint Sealant Butyl or polyisobutylene, nondrying, no skinning, non-curing.
4. Type GPI. General Purpose Interior Sealant Acrylic Emulsion Latex, ASTM C.834, Type OP, Grade NF Single component paintable
5. Type BTT Bathtub/Tile Sealant White silicone ASTM C 920 Uses I, M and A Single component
6. Type ACU Acoustical Sealant Butyl or Acrylic Sealant ASTM C 920, Grade NS, Class 12-1/2.Uses M and A
7. Type IFJT Interior Floor Joint Sealant Polyurethane, self - leveling, ASTM C 920, Grade Class 25 Uses T, M and A Single component
8. Type PAV Concrete Paving Joint Sealant Polyurethane, self-leveling, ASTM C 920, Grade Class 25 Uses T, I, M and A Single component
9. Accessories Primer, Non staining type, Joint Backing Round foam rod compatible with sealant, Bond Breaker Pressure sensitive tape recommended by manufacturer

PART 3 - Execution

3.1 Typical Location

A. Variable areas from expansion control to finishes.

3.2 Installation

A. Installation shall be in compliance with manufacturer's recommendations.

B. Perform installation in accordance with ASTM C 1193.

C. Perform acoustical sealant in accordance with ASTM C 919.

D. Joint width to depth to meet manufacturer recommendations for product.

E. Install bond breaker where joint backing is not used.

F. Install within approved temperature ranges.

G. Pre-compressed Foam sealant should not be stretched and joints avoided except at ends, corners and intersections. Install with face 1/8 to ‘1/4 inch below adjoining surfaces.

H. Performed field-adhesion testing in accordance with ASTM C1193, Method A or ASTM C1521, Method A.

3.3 Preparation

A. Clean and prepare substrates to produce a dust-free dry surface free from grease, oil or loose materials.

B. Remove incompatible materials which may affect bond.

3.4 Protection / Cleaning

A. Protect sealants until cured.

B. Protect sealants during construction period.

C. Clean adjacent soiled surfaces.

END OF SECTION 07 92 00

Division 08 – Openings

08	06	10	Door Schedule
08	11	13	Hollow Metal Doors and Frames
08	14	16	Flush Wood Doors
08	31	13	Access Doors and Panels
08	41	13	Aluminum-Framed Entrance and Storefronts
08	42	29	Automatic Entrances
08	71	00	Door Hardware
08	80	00	Glazing

SECTION 08 06 10 – DOOR SHEDULE

PART 1 - General

1.1 Door numbering to correspond with room numbers.

The following is an example format of a door schedule.

Name of Project

DOOR SCHEDULE

DR. NO.	DOOR						FRAMES			DETAILS			HWD SET	FIRE RATE.	REMARKS
	NOM. OPNG														
	Wdth.	Ht.	Thick.	Type	Mat.	Fin.	Type	Mat.	Fin.	Head	Jamb	Sill			
100	PR. 3'-0"	7'-0"	1 3/4"	CC	AL/GL	-	AA	HM		15/A10.2	15A/10.2		1		
101	3'-0"	7'-0"	1 3/4"	CC	AL/GL	-	AA	HM		15/A10.2	15/A10.2		1		
102	3'-0"	7'-0"	1 3/4"	A	S.C.	LAM-	A	HM	PT	20/A10.1	20/A10.1		3		
103	PR. 3'-0"	7'-0"	1 3/4"	A	HM	PT-	B	HM	PT	13/A10.2	14/A10.2		4		
104	3'-0"	7'-0"	1 3/4"	A	S.C.	LAM-	A	HM	PT	20/A10.1	20/A10.1		2		
105	3'-0"	7'-0"	1 3/4"	A	S.C.	LAM-	A	HM	PT	20/A10.1	20/A10.1		2		
106	PR. 3'-0"	7'-0"	1 3/4"	CC	AL/GL	-	AA	HM		20/A10.1	20/A10.1		6		
107	PR. 3'-0"	7'-0"	1 3/4"	AA	HM	PT-	AA	HM	PT	21/A10.1	21/A10.1		5		

LEGEND:

WD: WOOD DOOR;
NAT: NATURAL FINISH
HM: HOLLOW METAL DOOR /FRAME
AL: CLEAR ANODIZED ALUMINUM
GL: TEMPERED GLASS

NOTE:

1. Write typical notes in this location, and write corresponding number in the Remarks column.
2. SEESPECIFICATIONS FOR HARDWARE SETREQUIREMENTS
3. PROVIDE ALUMINUM THRESHOLDS AT ALL EXTERIOR DOORS AS SCHEDULED

END OF SECTION 08 06 10

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - General

1.1 Reference Standards

A. SDI-100

ANSI/ICC A117.1 – American National Standard for accessible and Usable buildings and facilities; International Code Council; 1998.

ANSI A250.8-SDI-100

1.2 Quality Control

A. Knock down frames are not acceptable.

B. Frames shall be factory pre-assembled with mitered fully welded joints ground smooth and delivered to the job site with spreaders.

C. Specify only standard sizes.

D. Top of doors to be closed and flush, not an open channel

E. Fire rated doors and frames must bear the appropriate UL label.

F. If door closers or other special hardware is provided, backing must be installed.

G. Double doors should have removable astragals. This should be a key operation.

H. Doors to meet ADA clearance and size requirements.

1.3 ANSI A250.8-SDI-100Quality Control

A. Installation shall be in accordance with ASTM Fire Tests Report.

B. Qualifications; Company performing the work will demonstrate a successful five-year experience record in the installation of firestopping systems.

1.4 Warranty

A. Minimum 5 Year

PART 2 - Products

2.1 Materials

A. Exterior Doors
1. Heavy duty ANSI A 250.8 Grade: Level 3, galvanized and painted.
2. 14-gauge minimum frame
3. 16-gauge face sheet
4. Insulated: Min. R-4

B. Interior Doors
1. ANSI A 250.8 Grade: Level 2
2. 16-gauge minimum frame
3. 18-gauge face sheet

C. All doors and frames are to be shop primed applied uniformly; inside, outside, and under removable stops and trim.

All frames in masonry walls shall be grouted full with Portland cement grout.

PART 3 - Execution

3.1 Typical Location

A. Hollow Metal Doors and Frames
1. All support spaces such as mechanical, electrical, maintenance rooms. In interior, use only as required by code.
2. If double doors are used, a key operated removable mullion is required.

B. Hollow Metal Frames
1. Used at all doors throughout interior.

END OF SECTION 08 11 13

SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 - General

1.1 Reference Standards

A. National Wood Window and Door Association Standards AWI/AWMAC Architectural Quality Standards Illustrated, Section 1300

1.2 Quality Control

A. Hollow Core Doors are not acceptable.

B. Specify only standard sizes.

C. All wood doors shall be mortised from templates furnished by the hardware supplier and coordinated with the hollow metal supplier.

D. AWI Custom Grade

E. Doors to meet ADA clearance and size requirements.

1.3 Warranty

A. Lifetime of Installation

PART 2 - Products

2.1 Materials

A. All wood doors to be solid core, 5 ply, guaranteed against manufacturing defects for the life of the building.

B. Finish to be painted Birch or stained wood veneer.

C. Use structural composite lumber.

D. All edges of wood doors are to be sealed.

E. The species of wood used for the stiles should match the door.

F. Light panels required at classrooms and offices. Refer to Educational Standards.

G. Door stile should match veneer species.

PART 3 - Execution

3.1 Typical Location

A. Interior only

3.2 Installation

A. Doors should not be installed prior to building having dry conditioned air.

END OF SECTION 08 14 16

SECTION 08 31 13 – ACCESS DOORS AND PANELS

PART 1 - General

1.1 Quality Control

A. Trades should be coordinated to locate items needing access in grouped locations to minimize the number of access doors.

B. Sizes are to be coordinated with MEP documents

C. Access doors in public areas are to be locked.

D. Access doors to crawl spaces are to be locked.

E. Access doors in toilet rooms to be stainless steel.

PART 2 - Products

2.1 Finishes

A. The access panels should complement the adjacent finishes of walls or ceilings.

PART 3 - Execution

3.1 Typical Location

A. All maintenance points where immediate access is required.

B. In wall, for plumbing valves and fittings.

C. In ceiling – above ceiling cut off valves, dampers, filter units, j-boxes, meters.

3.2 Installation

A. Minimum sizes: Coordinate with MEP and with specific job requirements.

B. Plumbing valves, reset buttons, controls manometers:

10”x10” in wall

C. Plumbing fittings at toilets, mechanical filter banks, access hatches, areas requiring work access for unit replacement:

24”x24” in wall

D. Above ceiling cut off valves, duct dampers, fire or smoke dampers, meters, registers:
12”x12” in ceiling

E. HVAC filter units, remote duct dampers, remote fire dampers, remote electrical J-boxes, access hatches
24”x24” in ceiling

END OF SECTION 08 31 13

SECTION 08 41 13 – ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 - General

1.1 Reference Standards

A. ASTM E283, E330, and E331

1.2 Quality Control

A. New Construction
1. In new construction projects, finish to be clear anodized aluminum.
2. Ensure that door can handle the heavy traffic that is to be expected in a main entrance.
3. If door closers or other special hardware is provided, backing must be installed.
4. Doors to meet ADA clearance and size requirements.
5. At Northwest Vista, Samuels Glass Door to be provided

B. Renovations
1. In renovation projects, finish to match existing finish, unless renovation will completely remove all storefront systems.

1.3 Warranty

A. Provide a notarized warranty to the owner that the Aluminum Entrance and Glass suppliers and the respective Manufacturers of each product, that all parts of work in this Section, including insulating glass units shall be free from defects in materials, workmanship and installation for a period of 5 years from the date of Substantial completion.

PART 2 - Products

2.1 Materials

A. Factory pre-finish is required.

B. Window units to be fixed non operable.

C. Thermal break is to be provided at exterior locations.

D. The doors should have heavy duty continuous hinges.

E. Ensure that door is specified to handle the heavy traffic that is anticipated through the main entrances.

F. Automatic door hardware is to be located at all main entrances.

PART 3 - Execution

3.1 Typical Location

A. Aluminum Door and Frames systems are typically used as the entrance to a building.

B. Field Quality Control
1. Specify engaging a testing agency to perform a water spray in accordance with AAMA 501.2

END OF SECTION 08 41 13

SECTION 08 42 29 – AUTOMATIC ENTRANCES

PART 1 - General

1.1 Reference Standards

A. Underwriters Laboratories (UL) UL325

American National Standards Institute (ANSI) ANSI A156.10 National Fire Protection Associate (NFPA 101 Life Safety Code section 5-2.1.9

1.2 Quality Control

1. All major entrances to the building should have an ADA accessible automatic entrance.
2. Ensure that a door stop is in place to avoid damage to door system.
3. Ensure appropriate anchoring details
4. Mounting height above door.

PART 2 - Products

2.1 Materials Manufacturers

1. Actuator type: Wireless manually operated – push plate.
2. Stanley Magic Force Hardware
3. Visual Sensor

PART 3 - Execution

3.1 Typical Location

1. All major building entries and accessible routes

3.2 Coordination

1. Electrical
2. Glazing

END OF SECTION 08 42 29

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - General

1.1 Reference Standards

A. NFPA-80 - Standard for Fire Doors and Windows

B. NFPA-101 - Life Safety Code

C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations

D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities

E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products

F. UFAS - Uniform Federal Accessibility Standards

G. UL - Underwriter's Laboratories

H. WHI - Warnock Hersey International, Testing Services

I. State and Local Codes including Authority Having Jurisdiction

J. U.B.C.7-2-97 and UL10C

K. IBC-2012-International Building Code

L. BHMA – Builder's Hardware Manufacturer's Association

M. DHI – Door and Hardware Institute

N. NFPA-70 – National Electrical Code

1.2 Quality Assurance

A. Specify hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished.

B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying UL label or mark. Exit devices in non-labeled openings to be listed for panic.

C. Specify a site survey of the hardware installation be conducted after six (6) months of Alamo Colleges acceptance of the facility. Any item of hardware that is found to be defective shall be replaced at the manufacture expense. Any item of hardware found to be installed incorrectly shall, be repaired at the general contractor's expense. All hardware found to be loose or out of proper adjustment shall be adjusted for proper function and operation by the hardware installer.

D. All hardware shall be BHMA Grade 1.

1.3 Warranty

A. All finish hardware shall be specified with a Two- (2) year warranty, commencing with substantial completion of the project.

PART 2 - Products

2.1 Hinges

A. All hinges to be of one manufacturer: Select, Hager, Ives or Stanley.

B. Unless otherwise required, specify five-knuckle, heavy-duty, ball-bearing, button tip, full mortise template type hinges with non-rising loose pins. Specify non-removable pins for out swinging doors at secured areas

C. Exterior Door Hinges
1. Specify out-swinging door hinges of solid bronze, steel, aluminum or stainless steel with non-removable pins or security studs

D. Exterior Door Hinges
1. Stainless steel or steel polished and/or plated to match specified finish shall be provided. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof

E. Specify 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide (1 1/2 pairs). Doors over 1¾" through 2¼" thick, specify 5" x 5" hinges. Doors over 36 inches use 4 1/2" x 4 1/2" (2 pair) unless otherwise specified.

F. Specify heavy weight hinges on all doors over 36 inches in width.

G. At labeled door's steel or stainless steel, ball-bearing-type hinges shall be specified. For all doors equipped with closers specify ball-bearing-type hinges.

H. Finishes

1. At wood doors, hinges are to be plated to match adjacent hardware. At hollow metal doors, hinges are to be aluminum or stainless steel at exterior out-swinging doors.

I. Continuous hinges shall be Ives "112HD, 112HD-EPT, 600, 600-EPT or 700 series as specified or equal products manufactured by Select. Hinges shall be fire rated up to 90 minute and shall have been tested to carry a maximum door weight of 450 plus pounds.

2.2 Lock and Lock Trim

A. All of the locksets, latch sets, and trim to be specified of one manufacturer. Locks, passage sets and privacy sets shall be the product of Schlage Lock Co., "ND" series with Rhodes Vandlgard lever (No Substitutions Allowed). All locks, passage and privacy sets are to be specified in a dull chrome (626) finish. All locks and cylinders shall be prepared for large format Schlage interchangeable cores.

B. Specify metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors. All pairs of doors shall have a ¾" latch projection.

C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 4000 as specified in 3.02 Hardware Sets.
1. Hand of lock is to be easily reversible in the field or non-handed.
2. All lever trim is to be through-bolted through the door.
3. All pairs of doors shall be provided with a ¾" latch throw or projection.

2.3 Electronic Access Control Locksets – Hardwired Bored- Type

A. Manufacturer: "AD-300-CY" series, as manufactured by Schlage, an Allegion Company. No substitutions allowed.

B. Requirements: Hardwired electronic locksets shall comply with the following requirements.
1. Type: Heavy-duty, bored cylindrical, non-handed, field-reversible.
2. Backset: 2-3/4-inch standard, with 2-3/8-inch, 3-3/4-inch and 5-inch backset optional.
3. Latch bolt Throw: 1/2-inch with optional 3/4-inch throw available.
4. Chassis: Shall accommodate standard 161 cylindrical lock prep for 1-3/4-inch doors standard or 1-3/8-inch to 2-3/4-inch thick doors in 1/8-inch increments.
5. Applicable Standards:
   a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
   b. Compliant with ANSI Standard A156.25 and A156.2 Series 4000, Grade 1 strength and operational requirements.
   c. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security Requirement.
   d. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
   e. Compliant with ASTM E330 for door assemblies.

f. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada RSS-210.

6. Lockset Functions: Specify locks with following functions that are field configurable without taking the lock off the door. Include in hardware schedule.
   a. Classroom / Storeroom 70.
   b. Apartment 60.
   c. Office 50.
   d. Privacy 40.
7. Emergency Override: Lockset shall have the ability to utilize emergency mechanical key override with the following manufacturer's key systems in the lever
8. Levers:
   a. Vandal Resistance: Exterior (secure side) lever designed with ability to rotate freely while door remains securely locked, preventing damage to internal lock components from vandalism by excessive force.
   b. Levers shall operate independently of each other.
   c. Style: Rhodes
9. Power Supply:
   a. Required Power Supply: 12VDC or 24VDC. Max current draw not to exceed 250mA.
10. Adaptability:
    a. Open Architecture: Locksets manufactured with open architecture characteristics capable of handling new and existing access control software and credential reading technology.
    b. Field changeable Reader Modules: Lockset to have the ability to change credential reader technologies without being removed from door.
11. Switches: specify locksets with the following switches, standard:
    a. Door Position Switch
    b. Interior Cover Tamper Guard
    c. Mechanical Key Override
    d. Request to Exit
    e. Request to Enter
    f. Lock/Unlock Status (Clutch Position)
12. Credential Reader:
    a. *Credential readers to be Schage MT15 or MT11 or approved equal if not integrated into lockset*
    b. Credential Reader Configuration: Specify credential reader modules in the following configurations, and indicate in door hardware sets.
    c. Proximity and/or Proximity and keypad.
    d. Credential reader capabilities, which can be configured at lockset with handheld programming device and remotely by Partner integrated software to include, but may not be limited to:
13. Operation:
    a. Lockset System Interface as required:
       1) Wiegand or Clock & Data via PIB300 (Panel Interface Board)
       2) Directly via RS485
    b. Lockset to have real-time bidirectional communication between access control system and lock.

c. Credential Verification Time: less than 1 second.

d. When Utilized with Partner Integrated Access Control Network Software With Remote Commanding Capability: Lockset shall have ability to be remotely locked down or unlocked within 10 seconds or less while battery powered, without user interface at the device.

e. Upon Loss of Power to Lockset: Lockset shall have ability to manage access control offline in one of three methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:
   1) Fail locked (secured)
   2) Fail unlocked (unsecured)
   3) Fail As-Is

f. Upon Loss of Communication Between Lockset and Network: Lockset shall have ability to manage access control offline in one of four methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:
   1) Fail locked (secured)
   2) Fail unlocked (unsecured)
   3) Fail As-Is
   4) Fail to Degraded/cache mode utilizing cache memory with following selectable options:
      a) Grant access up to the last 1,000 unique previously accepted User IDs.
      b) Grant access up to the last 1,000 unique previously accepted facility/site codes.
      c) Remove from cache previously stored User IDs or facility/site codes that have not been presented to lock within the last 5 days.

g. Lockset shall have ability to be configured at door by handheld programming device and remotely by Partner integrated software the length of time device is unlocked upon access grant.

h. Lockset shall have the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device and remotely by Partner integrated software.

2.4 ELECTRONIC ACCESS CONTROL LOCKSETS – WIRELESS BORED-TYPE

A. Manufacturer: "AD-400-CY" series, as manufactured by Schlage, an Allegion Company. No substitutions allowed.

B. Requirements: Hardwired electronic locksets shall comply with the following requirements.
   1. Type: Heavy-duty, bored cylindrical, non-handed, field-reversible.
   2. Backset: 2-3/4-inch standard, with 2-3/8-inch, 3-3/4-inch and 5-inch backset optional.
   3. Latch bolt Throw: 1/2-inch with optional 3/4-inch throw available.
   4. Chassis: Shall accommodate standard 161 cylindrical lock prep for 1-3/4-inch doors standard or 1-3/8-inch to 2-3/4-inch thick doors in 1/8-inch increments.

5. Applicable Standards:
   a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
   b. Compliant with ANSI Standard A156.25 and A156.2 Series 4000, Grade 1 strength and operational requirements.
   c. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security Requirement.
   d. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
   e. Compliant with ASTM E330 for door assemblies.
   f. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada RSS-210.
6. Lockset Functions: Specify locks with following functions and include in the hardware schedule. Field configurable without taking the lock off the door
   a. Classroom / Storeroom 70.
   b. Apartment 60.
   c. Office 50.
   d. Privacy 40.
7. Emergency Override: Lockset shall have the ability to utilize emergency mechanical key override with the following manufacturer's key systems in the lever:
8. Levers:
   a. Vandal Resistance: Exterior (secure side) lever designed with ability to rotate freely while door remains securely locked, preventing damage to internal lock components from vandalism by excessive force.
   b. Levers shall operate independently of each other.
   c. Style: Rhodes
   d. Tactile Warning (Knurling): Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous by the authority having jurisdiction.
9. Power Supply:
   a. Lockset powered by four AA batteries with options for eight AA batteries or a 12V or 24V DC power supply.
   b. Lockset shall have ability to communicate battery status and battery voltage level by means of a handheld programming device at door and remotely by Partner integrated software.
10. Adaptability:
    a. Open Architecture: Locksets manufactured with open architecture characteristics capable of handling new and existing access control software and credential reading technology.
    b. Field changeable Reader Modules: Lockset to have the ability to change credential reader technologies without being removed from door.
11. Switches: Specify locksets with the following switches, standard:
    a. Door Position Switch
    b. Interior Cover Tamper Guard
    c. Mechanical Key Override
    d. Request to Exit
    e. Request to Enter
    f. Lock/Unlock Status (Clutch Position)
12. Credential Reader:

a. *Credential readers to be Schage MT15 or MT11 or approved equal if not integrated into lockset*

b. Credential Reader Configuration: Specify credential reader modules in the following configurations, and indicate in door hardware sets.

c. Proximity and/or Proximity and keypad.

d. Credential reader capabilities, which can be configured at lockset with handheld programming device and remotely by Partner integrated software to include, but may not be limited to:

13. Operation:

a. Lockset System Interface as required:

1) Wiegand or Clock & Data via PIB300 (Panel Interface Board)

2) Directly via RS485

3) *Genetec (readers and interface boards)*

b. Lockset to have real-time bidirectional communication between access control system and lock.

c. Remote Commanding By Partner Integrated Access Control Network Software: Battery-powered lockset shall have "Wake on Radio" feature causing activation of remote, wireless access control locksets, enabling activated locksets to be configured, locked or unlocked from a centralized location within 10 seconds or less without user interface at the device.

d. Local Commanding: Locksets shall have the ability to be configured, locked or unlocked locally by handheld programming device, in real-time.

e. When Utilized with Access Control Network Software With Remote Commanding Capability: Lockset shall have ability to be remotely locked down or unlocked within 10 seconds or less while battery powered without user interface at the device.

f. Real-time response of battery powered device capable of being configured at door by handheld programming device and remotely by Partner integrated software.

g. Upon Loss of Power to Lockset: Lockset shall have ability to manage access control offline in one of three methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:

1) Fail locked (secured)

2) Fail unlocked (unsecured)

3) Fail As-Is

h. Upon Loss of Communication Between Lockset and Network: Lockset shall have ability to manage access control offline in one of four methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:

1) Fail locked (secured)

2) Fail unlocked (unsecured)

3) Fail As-Is

4) Fail to Degraded/cache mode utilizing cache memory with following selectable options:

a) Grant access up to the last 1,000 unique previously accepted User IDs.

b) Grant access up to the last 1,000 unique previously accepted facility/site codes.

c) Remove from cache previously stored User IDs or facility/site codes that have not been presented to lock within the last 5 days.

i. Lockset shall have ability to be configured at door by handheld programming device and remotely by Partner integrated software the length of time device is unlocked upon access grant.

j. Lockset shall have the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device and remotely by Partner integrated software.

2.5 *Permanent Cylinders, Keying and Acceptable Suppliers*

A. *Specify locks and Exit devices requiring cylinders be prepared for Schlage large format interchangeable core 6 pin key System, All keys shall be manufactured of nickel silver material only. All exterior and interior locks shall be specified with keyed construction cores for the duration of the construction period by the hardware supplier. Construction cores are to be returned to the hardware supplier no later than thirty (30) days after the installation of permanent cores. Specify that hardware supplier provide ten- (10) construction keys and two- (2) construction control keys total (No Substitutions Allowed).*

B. *All permanent cores shall be supplied "1" bitted with two (2) blank, "0" bitted keys per core directly to the Alamo Colleges locksmith (signature required for proof of delivery. Key blanks must be "0" bitted for the Alamo Colleges locksmith to use the key as specified. Permanent keys delivered to Alamo Colleges "1" bitted keys shall be rejected.*

C. *Cores shall be Schlage 6 pin length large format FSIC (No Substitution) Everest 29 S, S123 Keyway. The cost for permanent cores shall be included in the Contractor's base bid.*

D. *All locks shall be keyed as directed by the Alamo Colleges Locksmith. The General Contractor shall be responsible for "ordering" permanent cores for all doors & cabinets from the manufacturer, but Alamo Colleges will be responsible for "scheduling keying direct with manufacturer" (not ordering). The Alamo Colleges Locksmith shall install all permanent cores and return all construction cores to the general contractor. The general contractor shall return the construction cores to the hardware supplier for credit.*

E. *Final coordination of pinning with end user will be by Alamo Colleges.*

F. *Contractor to coordinate installation of permanent cores with Alamo Colleges Locksmith prior to final completion and turn over.*

2.1 Exit Devices

A. All exit devices and trim, including electrified items, to be Von Duprin 99L or EL-RX-SD99L series (No Substitution).

B. All exit devices to be of a heavy duty, chassis mounted design, with one-piece removable covers,

eliminating necessity of removing the device from the door for standard maintenance and keying requirements.

C. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets (#06/Rhodes).

D. Exit Devices to be the modern push rail design. Finish shall be satin aluminum (628).

E. Exit Devices shall be convertible in the field to accept electrified operations with out purchasing completely new exit devices.

F. Exit Devices specified with card access shall be provided with Electric Latch Retraction ("EL"), Request to Exit ("RX") and Special Dogging (SD) on all single doors and both leafs of a pair of doors. These items will also require the PS914-2RS-BK series power supply, the EPT-10 power transfer or "CTW" transfer hinge as required.

G. All pairs of doors shall be specified with rim exit devices and a key removable mullion. Exceptions are double egress doors, doors held open by electromagnetic holders tied to the fire alarm system and doors that are used to repeatedly move large objects or equipment to and/or from one area to another area.

2.2 Surface- Mounted Door Closers

A. All closers shall be LCN XP4041 with the SCUSH, SHCUSH, EDA, PA or RA arm (No Substitutions Allowed).

B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle. All closers shall have been tested and passed a ten million-cycle test.

C. All closers to have adjustable spring power sizes 1 through 4 or 6 as specified and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.

D. Finish: Sprayed enamel finish shall match other hardware.

2.3 Automatic Door Openers (~~Not Required~~ Provide 1 at main entrance of building)

A. All automatic door openers shall be:
1. LCN #9531 STD - Single (Pull Side Mount)
2. LCN #9542 REG - Single (Push Side Mount)
3. LCN #9553 REG2 - Double (Push Side Mount) simultaneous
4. LCN #9553 STD2 - Double (Pull Side Mount) simultaneous

B. Specify two (2) each Hard Wired Actuators & Mounting Boxes (8310-853T x 8310-867F or 8310 867S) 4.5" diameter engraved with handicapped logo & push-to-open. Specify Weather Ring 8310-801 for

all exterior mounted Actuator's, and key operated "On/Off" switches #8310-806K at all Automatic operators.

2.4 Door Stops and Holders

A. Door stops to be specified for every door leaf. Every door to have a floor, wall, or an overhead stop.

B. Specify doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.

C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified.

D. Finish: Same as other hardware where available.

E. Acceptable Products:
1. Products as manufactured by Ives, Rockwood and Trimco are acceptable.

2.5 Push Plates, Door Pulls, and Kickplates

A. Specify products as manufactured by Ives, Rockwood and Trimco are acceptable.

B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16 gauge (.050 inches) thick stainless steel. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.

C. Where required, armor plates, edge guards and other protective hardware shall be supplied specified.

D. Finish: Same as other hardware where available.

2.6 Flush Bolts and Coodinators

A. Products by Ives, Rockwood and Trimco are acceptable. Finish shall match adjacent hardware.

B. Specify only at locations approved by code.

2.7 Thresholds and Seals

A. Products by National Guard Products, Reese and Zero are acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.

B. Seals shall comply with requirements of U.B.C. 7-2-97 and UL10C. All thresholds, door bottoms and weather stripping shall be specified with silicone inserts

2.8 Removable Mullions

A. Removable mullions will be Von Duprin KR9954 type with I/C mortise cylinders. Finish shall be sprayed aluminum (SP28). Provide one (1) Mullion Storage Bracket MT54 with every mullion supplied (No Substitutions Allowed).

2.9 Finishes

A. Special care is to be taken to specify uniform finish of all various manufactured items.

2.10 Door Silencers and Key Cabinet

A. Specify door silencers at all openings without gasket. Provide two- (2) each at each pair of doors and three (3) or four- (4) each for each single door

B. Specify a key cabinet Lund 1200 series equal to the total number of permanent cores plus 100% expansion.

PART 3 - EXECUTION OF AND/OR INSTALLATION

3.1 All doors on all campuses will be controlled by electronic access control. These standards apply to all doors.

3.2 Installation of Finish Hardware

A. Specify hardware to be installed by experienced finish hardware installers with a minimum of ten (10) years' experience in the installation of finish hardware
   1. Specifying factory certification of qualified installers shall be required for the installation of all card access products as certified by Schlage Lock Company (No Exception).
   2. All exterior doors specified with card access are also specified with the electric power transfer (EPT-10) or "CTW" transfer hinges & shall have conduit installed from the hinge to a junction box mounted above the ceiling for use with the installation of hard wired card access devices. Designer to coordinate with MEP

3.3 Example Hardware Sets and Wiring Diagrams

HARDWARE SET # 01 - ACCESS CONTROLLED

DOORS #
100

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	112HD EPT-DOOR HEIGHT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR9954-STAB-MT54	689	VON
1	EA	PANIC HARDWARE	RX-EL-SD-99-DT	628	VON
1	EA	PANIC HARDWARE	RX-EL-SD-99-NL	628	VON
4	EA	CYLINDER	20-079/20-061 AS REQUIRED	626	SCH
4	EA	FSIC CORE	23-030 X 3 BLANK KEYS	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	MOUNTING PLATE	4040-18PA	689	LCN
2	EA	SHOE SUPPORT	4040XP-30	689	LCN
2	EA	STOP SPACER	4040XP-61	689	LCN
2	EA	DOOR SWEEP	1015VA-DOOR WIDTH	CL	NGP
1	EA	THRESHOLD	525 SIA-FRAME WIDTH		NGP
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	POWER SUPPLY	PS914 900-BBK 900-2RS	LGR	VON
		WEATHER STRIP	PROVIDED BY THE DOOR MFG.		

HARDWARE SET # 02 - ACCESS CONTROLLED

DOORS #
107B

EACH TO HAVE:

1	EA	CONTINUOUS HINGE	112HD EPT-DOOR HEIGHT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	PANIC HARDWARE	RX-EL-SD-99-NL	628	VON
2	EA	CYLINDER	20-079/20-061 AS REQUIRED	626	SCH
2	EA	FSIC CORE	23-030 X 3 BLANK KEYS	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	16A-FRAME WIDTH PLUS 4"	CL	NGP
1	SET	SEALS	162S-HEAD & JAMBS	AL	NGP
1	EA	DOOR SWEEP	1015VA-DOOR WIDTH	CL	NGP

1	EA	THRESHOLD	625 SIA-FRAME WIDTH		NGP
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	POWER SUPPLY	PS914 900-BBK 900-2RS	LGR	VON

HARDWARE SET # 03 - ACCESS CONTROLLED

DOORS #

110B

EACH TO HAVE:

1	EA	CONTINUOUS HINGE	112HD EPT-DOOR HEIGHT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	PANIC HARDWARE	RX-EL-SD-99-NL	628	VON
2	EA	CYLINDER	20-079/20-061 AS REQUIRED	626	SCH
2	EA	FSIC CORE	23-030 X 3 BLANK KEYS	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	16A-FRAME WIDTH PLUS 4"	CL	NGP
1	SET	SEALS	162S-HEAD & JAMBS	AL	NGP
1	EA	DOOR SWEEP	1015VA-DOOR WIDTH	CL	NGP
1	EA	THRESHOLD	625 SIA-FRAME WIDTH		NGP
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	POWER SUPPLY	PS914 900-BBK 900-2RS	LGR	VON

HARDWARE SET # 04

DOORS #

105 113 115

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	INDICATOR DEADLOCK	B571 X (6) EACH 61510	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	COAT HOOK	582M	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET # 05 - ACCESS CONTROLLED

DOORS #
109

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	652	IVE
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MT-RHO-JD	626	SCE
1	EA	FSIC CORE	23-030 X 3 BLANK KEYS	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	POWER SUPPLY	PS906 900-BBK 900-4RL 900-4R	LGR	SCE

HARDWARE SET # 06 - ACCESS CONTROLLED

DOORS #
107A 111

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	652	IVE
1	EA	ELECTRONIC LOCK	AD-300-CY-70-MT-RHO-JD	626	SCE
1	EA	FSIC CORE	23-030 X 3 BLANK KEYS	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

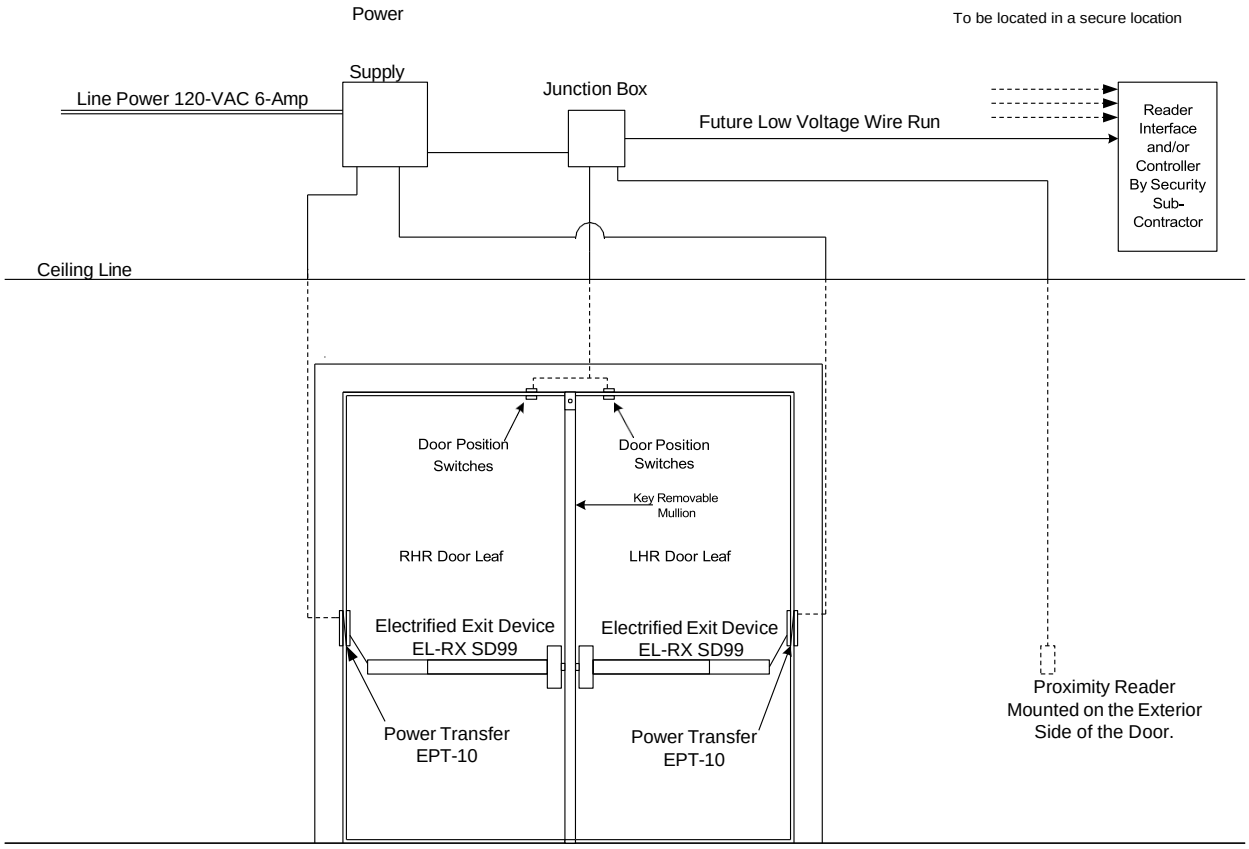
REFERENCE SHARED POWER SUPPLY SPECIFIED IN HARDWARE SET #05.

HARDWARE SET # 07 - MODULAR WALL SYSTEM DOOR

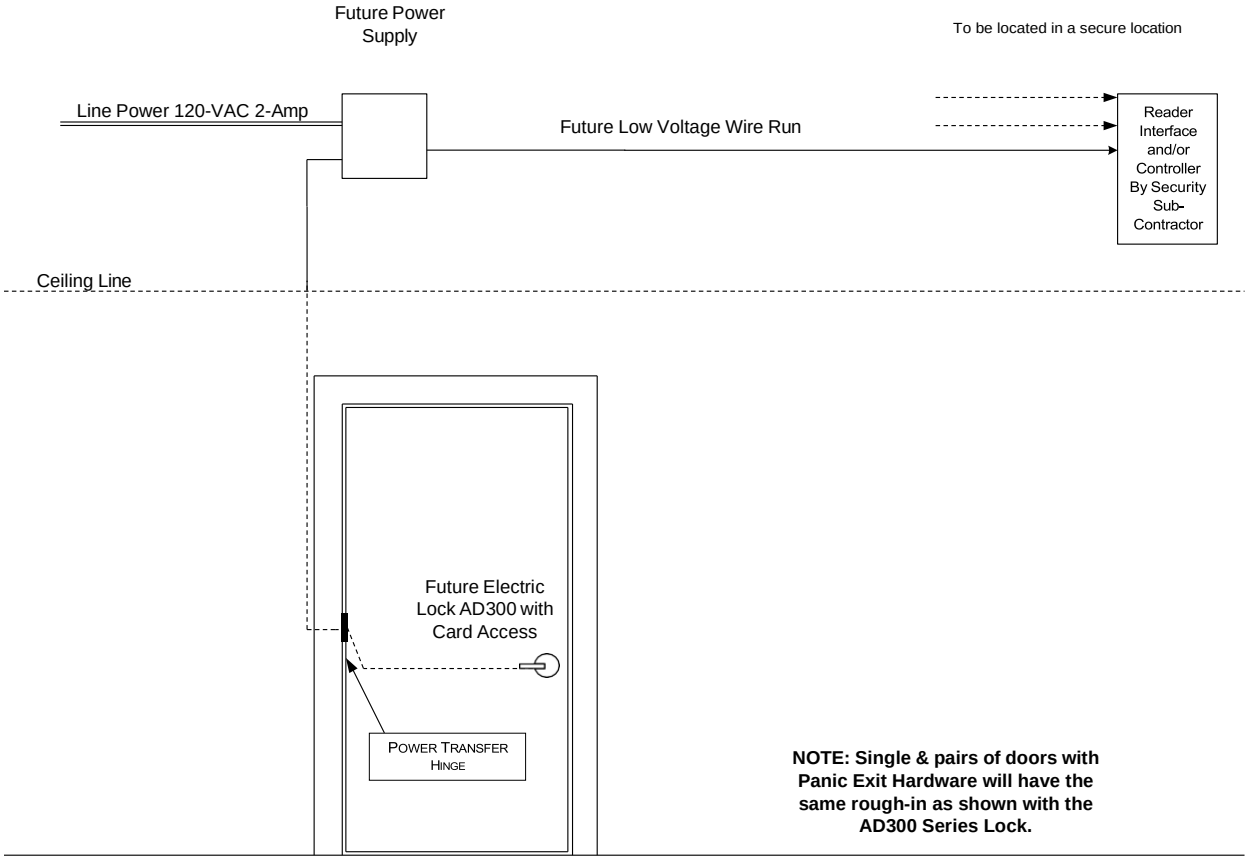
DOORS #
101 102 103 104 106A 106B
110A

EACH TO HAVE:

ALL HARDWARE PROVIDED BY THE MODULAR WALL SYSTEM MFG



Pair Exterior Doors With Electrified Exit Devices & Card Access



Single Interior Door with AD300 Series Access Control Lock

END OF SECTION 08 71 00

SECTION 08 80 00 – GLAZING

PART 1 - General

1.1 Reference Standards

A. ASTM E 773, E 774 class CBA

1.2 Quality Control

A. Glass with a film coating is not acceptable

1.3 Warranty

A. Minimum 5 Year

PART 2 - Products

2.1 Materials Manufacturers

A. Clear Glass

B. Low E Glass

C. Insulating Glass

D. Tinted Glass

E. Safety glazing – Tempered or laminated

F. Must be specified where required by codes, or when dictated by design judgment based on the intended application.

G. Exterior glazing to be clear low E insulated glass.

H. No reflective glass is to be used.

I. Manufacturers stamp is to be provided on all glass required by code to be heat tempered, heat strengthened or safety.

J. Northwest Vista College uses a smokey grey color glass.

K. Interior glazing to be a minimum of ¼" tempered.

L. Specify Design Wind Pressure requirements

PART 3 - Execution

3.1 Coordinate with Mechanical Engineer to evaluate heating and cooling loads for exterior glass. All

END OF SECTION 08 80 00

Division 09 – Finishes

09 00 00	Finish Schedule
09 29 00	Gypsum Board Assemblies
09 30 00	Tiling
09 30 13	Ceramic Tiling
09 51 13	Acoustical Panel Ceilings
09 65 13	Resilient Base and Accessories
09 65 16	Resilient Sheet Flooring
09 65 19	Resilient Tile Flooring
09 66 13	Portland Cement
09 68 00	Carpet
09 90 00	Painting

SECTION 09 00 00 – FINISHING SCHEDULE

PART 1 - General

1.1 The finish schedule below indicates the standard finish to be used for each space. Refer to the Educational Standards for additional finish requirements. Finishes are to be selected by the designer based on the Design and Construction Standards, Educational Standards, ACCD campus specific finishes, and programmatic requirements.

Space	Floor Finish	Base	Wall Finish	Clg. Finish	Notes
Building Lobbies Major Corridors	Terrazzo (preferred) Tile / Stained Concrete (optional)	Ceramic Tile (Terrazzo base only on buildings where change is very unlikely such as an auditorium)	Split Face CMU, Glazed CMU, Tile,	Gypsum Board and/or Acoustical Ceiling Tile	Materials chosen should be durable low maintenance materials
Minor Corridors	Carpet / VCT	Rubber	Paint	Acoustical Ceiling Tile	
Classrooms	Carpet or VCT	Rubber	Paint	Acoustical Ceiling Tile	
Administrative	Carpet Tile	Rubber Base	Paint	Acoustical Ceiling Tile	
Toilet Rooms	Ceramic Tile (12” x 12” preferred)	Ceramic tile coved tile base with pre- manufactured inside and outside corners.	Ceramic Tile 8’ high on all walls Note: All walls to use a cement board substrate.	Gypsum Board	Toilet Partitions – Solid Plastic or Solid Surface (ie: Corian) Countertops – Granite or Solid Surface (ie:Corian)
Cafeterias	Terrazzo (preferred) Tile / Stained Concrete (optional)	Tile	Ceramic Tile 8’ high	Gypsum Board and/or Acoustical Ceiling Tile (in food areas tile will need to be vinyl faced)	Servery to be stainless steel, granite, or solid surface with stainless steel tray slides bars.

Kitchens	**Quarry Tile**	**Quarry tile coved base, using pre-manufactured inside and outside corners.**	**FRP Panels**	**Gypsum Board or Acoustical Ceiling with vinyl face**	
Elevators	**Terrazzo or Ceramic Tile**		**Solid Surface Material or Stainless Steel**	**Elevator standard with down lights**	
Elevator Equipment / Electrical	**Sealed Concrete**	**Rubber**	**Paint**	**None / Acoustical Ceiling Tile**	
Mechanical Equipment	**Concrete with painted finish**	**Concrete Base**	**CMU Walls with painted finish**	**None**	

END OF SECTION 09 00 00

SECTION 09 29 00 – GYPSUM BOARD ASSEMBLIES

PART 1 - General

1.1 Reference Standards

A. UL rated assemblies manual ASTM C 840 – control joints

B. Gypsum Association Publications: GA 214, GA 216, GA 238, GA 253, GA 600.

1.2 Quality Control

A. Ensure Firestopping by code

B. Finish: Standard finish to be "orange peel".

1. Reference Gypsum Association GA-214 Quick Reference Guide for Finishing Levels as noted in the following sub-section.

a.

Finish Level		Application
1)	Level 1	Non-exposed partitions (above-ceiling, mechanical/electrical rooms)
2)	Level 2	Non-exposed partitions (above-ceiling, mechanical/electrical rooms)

For Levels 3, 4, and 5, jobsite mock-up(s) shall be used to determine acceptance of the finish within the building.

3)	Level 3	Exposed surface which are to receive heavy texture, wall coverings; not recommended for smooth wall designs or light textures, non-continuous textures
4)	Level 4	Exposed surface of interior spaces
5)	Level 5	Exposed surface of interior spaces where lighting is critical and surface imperfections are unacceptable

C. Plumb: All assemblies shall have a tolerance of 1/8" in 10' maximum.

D. All outside corners and furring to be floated with metal trim.

PART 2 - Products

2.1 Materials

A. Use 5/8" type X gypsum board at all walls.

B. Use only cement backer board or other substrates recommended by the gypsum association for application behind tile.

PART 3 - Execution

3.1 Typical Location

A. Partitions that extend to deck should include:
1. As required to meet fire code
2. Between classrooms
3. Toilet rooms
4. Electrical rooms
5. Mechanical room

B. Mechanical Rooms to have double layers of gypsum board and sound attenuation blankets.

3.2 Acoustical Design, Acoustical Performance Criteria, Sound Transmission, Noise Criteria

A. Unless specifically directed otherwise by the Program of Requirements (POR), the following standards shall be met in reference to Sound Transmission Class (STC) and Noise Criteria (NC).

B. Sound Transmission Class (STC)

1. Typical Location	STC Rating
a. Partitions between classrooms and corridors	45
b. Partitions between adjacent classrooms	50
c. Offices	40
d. Break room(s)	40
e. Toilet room(s)	40

C. Noise Criteria
1. Design in accordance with good practice to achieve conventional ambient noise levels qualified in Noise Criteria (NC) defined in current ASHRAE Applications Volume, Chapter 42 and ANSI S1.8 Reference Quantities for Acoustical Levels – ASA 84.
2. The ambient sound level of an occupied space is not to exceed the following NC listed for its respective typical occupancy unless specifically directed otherwise by the project Program of Requirements (POR). Spatial forms, materials, assemblies, systems and equipment selections are to be designed as required to achieve a standard quality of specified level of maximum background noise.

a. Typical Occupancy	Maximum Noise Criteria (NC)
1) Apartments/Dorms	
a) Individual rooms/suites	35

	b)	Meeting/Banquet rooms	35
	c)	Halls, corridors & lobbies	40
	d)	Service/support areas	45
2)	Offices		
	a)	Executive	30
	b)	Conference Rooms	30
	c)	Private	35
	d)	Open plan areas	40
	e)	Business machine areas	45
	f)	Public circulation	45
3)	Research		
	a)	Private rooms	30
	b)	Laboratories (Research & General)	35
	c)	Laboratories (Teaching)	30
	d)	Corridors	35
	e)	Public Areas	40
4)	Schools		
	a)	Lecture & classrooms	30
	b)	Open-plan classrooms	35
	c)	Lecture theaters	30
5)	Libraries		35
6)	Performing Arts		
	a)	Theater	25
	b)	Stagehouse	25
	c)	Trap room	25
	d)	Orchestra pit	25
	e)	Rehearsal rooms	25
	f)	Teaching studios	30
	g)	Practice rooms	30
	h)	Ensemble rooms	30
	i)	Shop	45
7)	Recording studios:		
	a)	Recording room	20
	b)	Sound control room	25
	c)	Other control rooms	25

3. These conventional standards of the level of ambient noise in a space are independent of and prior to the installation of any Owner-furnished equipment, furniture and furnishings

unless specified otherwise. Other resource material describing conventional ambient noise criteria is available in the current edition of Ramsey/Sleeper Architectural Graphic Standards.

END OF SECTION 09 29 00

SECTION 09 30 13 – CERAMIC TILING

PART 1 - General

1.1 Reference Standards

A. ASTM C 1028 Static Coefficient of Friction.

B. ANSI A118.10, ANSI A118.4

C. ANSI A 137.1 American National Standards Specifications for Ceramic Tile

D. Tile Council of America – Handbook for Tile Installation

1.2 ANSI 108

A. Finish to be matte on floor to meet requirements of heavy traffic.

B. Contractor to provide written cleaning and maintenance instructions with pre-submittal completion close-out documentation.

C. Building mockup of each type of installation.

D. Installer shall be member of national tile contractors association.

PART 2 - Products

2.1 Materials Manufacturers

A. Floor Tile

B. Commercial ceramic tile for heavy traffic.
1. Toilet Room tile to be 8” x 8” – 12” x 12”.
2. Lobbies and Corridors to be 12” x 12” – 24” x 24”
3. Matte finish with a heavy commercial rating.
4. Medium to dark grouts to be used.
5. Appropriate trims to be used as needed.
6. Tile used as an exterior surface must meet minimum requirements for coefficient of friction.

C. Wall Tile
1. Commercial ceramic tile

2. Toilet Room Tile to be 4” x 4” – 12” x 12”.
3. Lobbies and Corridors to be 12” x 12” – 24” x 24”
4. Matte or glazed finish acceptable.
5. Medium to dark grouts to be used.
6. Use appropriate trims as needed.
7. Coved base is required standard in toilet rooms and kitchens, with pre-manufactured inside and outside corners.

2.2 Other Materials Requirements

A. Waterproofing Membrane
1. ANSI 118.10
Use fabric-reinforced, modified –bituminous-sheet product: Self adhering SBS-modified bituminous sheet with woven reinforced facing for adhering to latex-portland cement.

B. Setting and Grouting Materials
1. Latex-Portland Cement Mortar – ANSI 118.4
2. Epoxy Grout – ANSI A 118.3

C. Attic Stock

PART 3 - Execution

3.1 Typical Location

A. Toilet Rooms
1. Main public toilet rooms to use tile:

3.2 Throughout floor area

A. 8’ minimum height on all walls

B. Epoxy grout at all public toilets

C. Installation

D. Floor drains and waterproofing membrane at all toilets.

E. Lobbies and Corridors

F. Tile is one of the accepted materials for use in the Lobbies and major corridors.
1. Tile on walls in lobbies and major corridors to be a minimum height of 4’.

3.3 Installation

1. As per manufacturer's recommendations.
2. Use no more than 1/8" grout joints typical.
3. At glazed wall tile use 1/16" grout joints.
4. Tile in kitchen areas must be sealed as recommended by manufacturer.

3.4 Preparation/Protection / Cleaning

1. As per manufacturer's recommendations.

END OF SECTION 09 30 13

SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 - General

1.1 Reference Standards

A. Standard products
1. Edge condition: Panels shall be no less than 6" where adjacent to wall. Edge trim shall be "L" type.
2. Products shall not contain any asbestos materials.
3. Install per ASTM C 636.
4. Maximum deflection in suspension system 1:360
5. Maximum variation from flat and level: 1/8" in10'.
6. Maximum variation from plumb in grid system: 2 degrees.

B. Specialty products

C. Use specialty tile where required for sanitation, clean rooms, or other special functions.

1.2 Warranty

A. Ten-year warranty on suspension system, and a one-year warranty on acoustical ceiling tile.

PART 2 - Products

2.1 Manufacturers

A. Armstrong Ultima #1911 or approved equal. Beveled Tegular Ceiling with 15/16" grid.

B. *CentainTeed Symphony m75 or approved equal. Beveled Tegular Ceiling with 15/16" grid*

C. *USG Mars ClimaPlus 86185 or approved equal Beveled Tegular Ceiling with 15/16" grid*

2.2 Materials

A. 24" x 24" x 5/8" lay-in acoustical ceiling tile fine texture with impact and scratch resistance.

2.3 Finishes

A. White

PART 3 - Execution

3.1 Typical Location

A. Throughout majority of spaces.

B. Use specialty tile where required for sanitation, clean rooms, or other special functions.

3.2 Installation/Protection / Cleaning

A. Per manufacturer's recommendations.

END OF SECTION 09 51 13

SECTION 09 65 13 – RESILIENT BASE AND ACCESSORIES

PART 1 - General

1.1 Quality Control

A. Base
   1. 4” coved rubber base to be used, vinyl base is not acceptable.

B. Accessories
   1. Rubber flooring can be used on pedestrian style stairwells. Other stairwell i.e. exit stairs, shall be concrete.
   2. Transition strips, stair nosings, and treads to be rubber, vinyl is not acceptable.

1.2 Warranty

A. 5 year limited warranty.

PART 2 - Products

2.1 Materials Manufacturers

A. Base
   1. 4” coved rubber base required.
   2. In large open areas, continuous base is preferred.
   3. Corners to be pre-molded rubber (both inside and outside corners)

B. Accessories
   1. Rubber stair nosings, and stair treads and risers. Use heavy duty grade.
   2. Rubber accessories and transition strips. Use heavy duty grade.

PART 3 - Execution

3.1 Typical Location

A. Base
   1. Resilient base shall be used at all carpeted and resilient flooring areas.

B. Accessories

1. At flooring transitions as needed.
2. At stair as needed.

3.2 Installation / Protection / Cleaning

1. Base and accessories to be installed using heavy duty epoxy adhesive.
2. Per manufacturer's recommendations.

END OF SECTION 09 65 13

SECTION 09 65 16 – RESILIENT SHEET FLOORING

PART 1 - General

1.1 Reference

1.2 Vinyl: ASTM F 1303 Type II with backing

1.3 Linoleum: ASTM F2034 with backing

1.4 Warranty

A. 5 year limited warranty

PART 2 - Products

2.1 Materials / Finishes

A. Vinyl Sheet Goods

B. Linoleum

PART 3 - Execution

3.1 Typical Location

A. Vinyl Sheet Goods
   1. Laboratories, and clean-rooms.

B. Linoleum
   1. Corridors, and specialty areas.

3.2 Installation/ Protection / Cleaning

A. Seams to be heat welded.

B. Per manufacturer's recommendations.

C. Perform anhydrous calcium chloride test per ASTM F1869.

END OF SECTION 09 65 16

SECTION 09 65 19 – RESILIENT TILE FLOORING

PART 1 - General

1.1 Reference Standards

A. Vinyl Tile – ASTM F 1066

B. Rubber Tile – ASTM F 134

1.2 Quality Control

A. Vinyl Tile
1. Asbestos-containing materials shall not be used.

B. Rubber Tile

1.3 Warranty

A. 5 year limited warranty.

PART 2 - Products

2.1 Materials Manufacturers

A. Vinyl Composition Tile
1. Use of solid color tile is discouraged.
2. Homogeneous – through pattern 0.125-inch thickness

B. *Resilient Tile Flooring (LVT)*
1. *Commercial grade, high performance top layer on reinforced commercial flooring base with commercial backing layer*
2. *Overall thickness: 1/8" (4 mm) minimum thickness*
3. *Wear layer: 20 mil (.5 mm) minimum thickness*
4. *Square edge, low emboss*
5. *Mannington City Park*
6. *Shaw Terrain II*
7. *Tarkett iD Latitude*

C. Rubber Tile
   1. Homogeneous – color and pattern throughout 0.125-inch thickness

PART 3 - Execution

3.1 Typical Location

A. Vinyl Tile
   1. High traffic areas.

B. Rubber Tile
   1. May be used in athletic rooms, for non-slip ramps as one option per architect/designers selection, and in areas where there is a need to provide sound control.

3.2 Installation/ Protection / Cleaning

A. Per manufacturer's recommendations.

B. Test for moisture emission rate and alkalinity per ASTM F 710 to within limits recommended by tile and adhesive manufacturer recommendations.

END OF SECTION 09 65 19

SECTION 09 66 13 – PORTLAND CEMENT AND TERAZZO FLOORING

PART 1 - General

1.1 Quality Control

A. Provide control joints as needed.

B. Reference Standard NTMA “Terrazzo Specifications and Design Guide”.

PART 2 - Products

2.1 Materials

A. New Construction
1. Use 3” thick cementitious Terrazzo with sand cushion or ¼” – ½” thick thin-set Terrazzo withy flexible epoxy membrane containing no VOC’s or plasticizers.

B. Renovations
1. Use ¼” – ½” thick thin-set Terrazzo. Use flexible epoxy membrane containing no VOC’s or plasticizers.

2.2 Finishes

A. Patterns and colors to be designed and selected by architect/designer.

PART 3 - Execution

3.1 Typical Location

A. Lobbies, stairwells, corridors, cafeterias.

3.2 Installation/ Protection / Cleaning

A. Only qualified installers can be used for installation. Per manufacturer’s recommendations.

END OF SECTION 09 66 19

SECTION 09 68 00 – CARPETING

PART 1 - General

1.1 Reference Standards

A. CRI – Carpet and Rug Institute

1.2 Quality Control

A. Maintenance – refer to manufacturers recommendations for cleaning

B. Broadloom carpet is not preferred. Only special applications with approval of ACCD facilities will be permitted.

1.3 Warranty

A. Minimum 1 Year Installation from date of substantial completion. 15-year carpet material from date of substantial completion.

PART 2 - Products

2.1 Materials

A. Carpet Tiles should be used throughout the district.

B. Static control: Static rating shall be under 2kV in computer labs and under 3.5 kV elsewhere

C. Provide 5% over-stock, with a minimum of one box of tile.

D. Adhesives: water resistant, mildew resistant, non-staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

E. Carpet should have antimicrobial treatment.

F. Critical Radiant Flux Classification: not less than .45 w/sq. cm.

PART 3 - Execution

3.1 Typical Location

A. Offices, conference rooms.

3.2 Installation

A. Glue down, install every tile with releasable adhesive.

B. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets edgings, thresholds, and nosings.

C. Bind or seal cut edges as recommended by carpet tile manufacturer.

D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

END OF SECTION 09 68 00

SECTION 09 90 00 – PAINTING

PART 1 - General

1.1 Reference Standards

A. ASTM D 16 – Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. ASTM D 4442 – Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Reapproved 2003)

C. ASHRAE Sted 62 – Ventilation for Acceptable Indoor Air Quality; 2001

D. ASHRAE Sted 129 – Measuring Air-Change Effectiveness; 1997 (reaffirmed 2002)

E. SMACNA (OCC) – IAQ Guideline for Occupied Buildings Under Construction; 1995

1.2 Quality Control

A. In occupied buildings, low VOC is a requirement. This also will assist with any LEED's credits if needed.

B. Oil based paints are not accepted.

C. All similar coatings shall be from a single source.

D. Provide mockups of each type, color and texture.

1.3 Warranty

A. One year.

PART 2 - Products

2.1 Manufacturers

A. Use 'first line" products from one of the following manufacturers.
   1. Sherwin Williams
   2. ICI Dulux

2.2 Materials

A. Material Paint Schedule
1. Wood and metals to use Alkyd primer and paint.
2. Ferrous metals to use a metal primer.
3. Gypsum Board to use a Latex primer and paint.
4. Primers shall be type as recommended by manufacturer and as approved by Architect.
5. Paints to be orange peel texture.
6. Follow manufacturer's recommendations on materials for primers and top coats.
7. Paint in toilet rooms to be Epoxy only.

B. Interior Paint Schedule
1. Wall shall receive a primer with two (2) coats of semi-gloss final coat paint.
2. Trim shall receive a primer with two (2) coats of gloss final coat paint.
3. Ceilings shall receive a primer with two (2) coats of flat final coat paint.

2.3 Finishes

A. Northwest Vista
1. SW 1101 China Doll
2. SW 1099 Knubby Wool
3. B55W102 C/M Vista Road

PART 3 - Execution

3.1 Typical Location

A. Throughout

3.2 Installation/ Protection / Cleaning

A. Per manufacturer's recommendations.

B. Test for moisture emission rate and alkalinity per ASTM F 710 to within limits recommended by tile and adhesive manufacturer recommendations.

END OF SECTION 09 90 00

Division 10 – Specialties

10	11	16	Marketboards
10	11	23	Tackboards
10	14	01	Interior Signage
10	14	02	Evacuation Signage
10	21	13	Toilet Compartments
10	26	00	Wall and Door Protection
10	28	13	Toilet Accessories
10	40	00	Safety Specialties
10	51	13	Metal Lockers

SECTION 10 11 16 – MARKERBOARDS

PART 1 - General

1.1 Materials

A. Markerboard Panel: Porcelain enamel finish shall be fusion bonded to 24-gauge steel substrate at temperature necessary to reduce steel and porcelain stresses and achieve superior enamel bond and hardness. Trim and tray are to be satin anodized aluminum
   1. Face Plate: 24 gauge LCS Marker board
   2. Core Material: 7/16” MDF; 7/16” Duracore; or 3/8” Duracore
   3. Panel Backing: Moisture barrier back 0.005” aluminum foil panel or 0.015” aluminum foil panel.
   4. Writing surface to be a low gloss surface of 65-75% of reflectivity.

1.2 Finishes

A. White Board with satin anodized aluminum trim and tray.

PART 2 - Execution

2.1 Typical Location

A. Chalkboards
   1. Classrooms as needed based on educational standard requirements.
   2. Conference rooms.

END OF SECTION 10 11 16

SECTION 10 11 23 – TACKBOARDS

PART 1 - General

1.1 Warranty

A. One year against defect in materials and workmanship. Warranty does not cover normal wear and tear, improper handling, misuse, or vandalism.

PART 2 - Products

2.1 Materials

A. Tackboards:
1. Composed of ¼" thick self-healing, burlap backed cork laminated to a ¼" hardboard backing.
2. Linoleum can be used as is alternate option for tack surface.

2.2 Finishes

A. Cork or Linoleum

PART 3 - Execution

3.1 Typical Location

A. Tackboards
1. Classrooms as needed based on educational standards and requirements.
2. Corridors as needed.

END OF SECTION 10 11 23

SECTION 10 14 01 – INTERIOR SIGNAGE

PART 1 - General

1.1 Quality Control

A. Refer to Alamo Colleges District Graphic Standards for font and color guidance.

B. -All signs to comply with all applicable codes and standards such as, but not limited to, ADA, TAS, IBC, NFPA.

C. Numbering to be as approved by Facilities and Construction Management.

D. Sign text to be approved by Facilities and Construction Management as reviewed by College Services representative and end user

1.2 Warranty

A. five (5) year warranty endorsed by the manufacturer and the Contractor warranting signs against fastener and/or adhesive failure; coating failure including peeling, fading in excess of 5 NBS units and chalking; shrinking or peeling of appliqués on signs; or failures of any other type which render the signs unsightly and/or unreadable.

PART 2 - Products

2.1 Manufacturers

A. Claridge Products and Equipment, Inc. or approved equal

2.2 Materials

1. Tactile Signs:
   a. Photo-polymer process plastic type at interior with lettering and Braille translations raised 1/32" from the background; total thickness as required to comply with applicable regulations. Provide a minimum thickness at any point at completion of fabrication of not less than 0.0625"; laminate onto 0.10" thick acrylic backplate with permanent adhesive.
2. Signs installed at exterior or in interior humid environments:
   a. zinc or magnesium metal types, provide minimum thickness of not less than 0.125". Provide square edges and corners.

B. Accessories to include:
1. Tamper proof mounting screws
2. Insert windows
3. Memo strips.

2.3 Finishes

A. To be selected from manufacturer's standard finishes. Medium to dark colors preferred.

PART 3 – Execution

3.1 Typical Location

A. All permanent rooms, as required by code, and where requested on furniture/modular offices.

3.2 Installation

A. All signs identifying permanent rooms and spaces shall be located per current ADA and TAS requirements. Interior signs shall be anchored to the wall using adhesive, unless otherwise noted. Signs placed on the exterior of the building shall be anchored with appropriate expansion bolts.

3.3 Back plates

A. Provide where mounted on glass or where obverse of sign is visible through the structure it is mounted on.

END OF SECTION 10 14 01

SECTION 10 14 02 – EVACUATION SIGNAGE

PART 1 - General

1.1 This section outlines requirements for Emergency Evacuation Signage that is required on all ACD projects.

A. These signs are required in addition to Code required signage covered elsewhere in this standard

B. Evacuation maps are a basic floor plan indicating rooms, exits and stairwells, severe weather shelter areas and primary and secondary emergency escape routes in a format that is easy to follow in an emergency.

1.2 Quality Control

A. Refer to Alamo Colleges District Graphic Standards for font and color guidance.

B. Room numbering to match the as-built plans and shall be as approved by Facilities and Construction Management.

C. Sign text, graphics, and mounting locations to be approved by Facilities and Construction Management as reviewed by College Risk Management representative and end user

D. Use provided template as shown below in Part 2

1.3 Warranty

A. five (5) year warranty endorsed by the manufacturer and the Contractor warranting signs against fastener and/or adhesive failure; coating failure including peeling, fading in excess of 5 NBS units and chalking; shrinking or peeling of appliqués on signs; or failures of any other type which render the signs unsightly and/or unreadable.

PART 2 - Products

2.1 Design

A. Evacuation signage is required in all classrooms, open office spaces, lounges, multi-purpose rooms, any other gathering areas and as requested by ACD Risk Management representative

B. One sign per room, mounted near the main entrance to the area

C. Plan north on each sign is to be oriented to the wall on which it is mounted such that when viewing, the exit routes on the plan will be oriented to the viewer (see Figure 1 and note the north arrow orientation).

D. Room names and numbers on each orientation of the sign will be standard, left to right reading.

E. Signs to be formatted per the template provided with all required information shown in Figure 1



Figure 1

2.2 Suppliers

A. Thomas Printworks, San Antonio or approved equal

2.3 Materials

1. 12” x 12” clear, pre drilled acrylic standoff frame with 1/8” minimum substrate and cover plate with rounded corners configured to receive photo quality color insert.
2. 12” x 12” photo quality color insert for each location.
   a. Fade resistant, high resolution image with true color representation
   b. Dry, friction fit in frame without adhesive

2.4 Mounting:
1. ¾” x 1” Stainless steel standoffs and mounting screws

PART 3 – Execution

3.1 Typical Locations:

A. All classrooms, corridors, open office areas and where requested by Risk Management.

3.2 Installation

A. Mount to wall with mounting screws and lag anchors or toggle bolts as required.
B. Install clear of door swings at 60” above finish floor to top of frame

3.3 Back plates

A. Provide where mounted on glass or where obverse of sign is visible through the structure it is mounted on.

END OF SECTION 10 14 02

SECTION 10 21 13 – TOILET COMPARTMENTS

PART 1 - General

1.4 Quality Control

A. Plastic Laminate or painted metal partitions are not acceptable.

B. Hardware and fittings must be heavy duty/institutional grade.

C. Provide structural support as required if partitions are to be ceiling mounted.

1.5 Warranty

A. 20-year warranty against breakage, delamination, and corrosion of solid plastic parts. Warranty does not include installation errors, improper usage, or vandalism.

PART 2 - Products

2.2 Manufacturers

A. For High Density Polypropylene or stainless steel partitions:
   1. Hadrian, Comtec Capitol Partitions or equal.

B. For Solid Surface/ Solid Color Reinforced Composite Material partitions:
   1. Bobrick, Corian, WilsonArt

2.3 Materials

A. Partitions and Hardware to be Institutional Grade. Doors, panels, and pilasters to be one of the following:
   1. High density polypropylene solid polymer. Floor mounted.
      a. Doors to be 1", thick 55" high.
      b. Pilasters to be 1" thick, 82" high.
      c. Provide headrails for durability and stability, of extruded aluminum construction with anti-grip design.
      d. Hardware and Fittings to be heavy duty extruded aluminum hinges that wrap both door and pilaster and to be full length continuous hinge system. Heavy duty brackets required.
   2. Textured Stainless Steel. Floor or ceiling mounted.

a. Two sheets of panel flatness type 304 #4 brushed finish rigidized stainless steel laminated under pressure to a "verticel" ½" honeycomb core.
b. Doors to be 1" thick 55" high with cover sheets not less than 22 ga. (panels wider than 46" are 20 ga.)
c. Pilasters to be 1 "thick with cover sheets not less than 18 ga.
d. Hardware and Fittings to be chrome plated zinc die castings, standard. Doors shall be equipped with a gravity type hinge. Hinges shall be the wrap around type and adjustable.
e. Provide structural support as required if ceiling mounting partitions.

3. Solid Surface Material / Solid Color Reinforced Composite Material. Floor mounted.
   a. Doors to be 3/4", thick 55" high.
   b. Pilasters to be 3/4" thick, 82" high.
   c. Provide headrails for durability and stability, of extruded aluminum construction with anti-grip design.
   d. Hardware and Fittings to be stainless steel. Hinges that wrap both door and pilaster. Heavy duty brackets required.

B. Accessories to include:
   1. Coat hook, stainless steel.
   2. Shelf
      a. Solid Surface built into wall
      b. Stainless Steel fold-down with heavy duty hinge.

2.4 Finishes

A. To be selected from manufacturer's standard finishes. Medium to dark colors preferred.

B. For stainless steel partitions, finish to be textured

PART 3 - Execution

3.4 Typical Location

A. All toilet rooms.

3.5 Installation

A. Install per manufacturer's instructions.

3.6 Protection / Cleaning

A. Clean per manufacturer's instructions.

END OF SECTION 10 21 13

SECTION 10 26 00 – WALL AND DOOR PROTECTION

PART 1 - General

1.1 General Requirements

A. There is no standard for wall and corner guards. Each project will dictate the type of guard and its location.

B. ACCD prefers recessed corner guards when used. This will need to be planned and specified in construction documents.

PART 2 - Products

2.1 Materials

A. Vinyl, plastic, wood, or stainless steel guards including corner guards and wall guards.

B. At day care facilities finger guards are required.

PART 3 - Execution

3.1 Typical Location

A. Design team shall review locations for corner and wall protection with ACCD. Note ACCD prefers recessed corner guards.

B. As a general rule protection of outside corners of gypsum board partitions in public corridors and lobbies needs corner protection to wainscot height. Spaces with moveable seating or carts should also consider wall protection at chair rail height at gypsum board partitions.

END OF SECTION 10 26 00

SECTION 10 28 13 – TOILET ACCESSORIES

PART 1 - General

1.1 General Requirements

A. ACD has standard paper and supply products that they purchase. The specifications for these products shall be confirmed with ACD prior to final documentation. ACD also shall confirm if the contractor is to purchase those products or if ACD will purchase those products directly through the vendor

PART 2 - Products

2.1 Manufacturers

A. Bobrick

B. American Specialties

C. Dyson

2.2 Products

A. The standards are as follows; equal products are acceptable:

B. Paper Towel Dispenser & Waste Receptacle:
1. MOD* MANUAL TOUCHLESS HARD ROLL TOWEL DISPENSER, BLACK #34346 (Dispenses one 8" diameter roll of 700' or 1150' product plus stub roll utilizing core plug mounting) *or equal*.
2. Receptacle is 12 gallons. Can be fully recessed or surface mounted
3. Note semi-recessed or fully recessed is preferred. Architect to coordinate wall depth to accommodate selected unit.
4. *Combination units will be Contractor Furnished/Contractor installed*

C. Electric Hand Dryer Dyson Air Blade (Installed and Operational)
1. Contractor Furnished Contractor Installed
2. Input voltage: Low Voltage = 110-127 V, Frequency: Low Voltage = 50 or 60 Hz, subject to voltage
3. Rated power: 1400 W
4. Motor type: Dyson digital motor V4 – brushless DC Motor Motor switching rate: 6,100 per second
5. Motor speed: 92,000 rpm

6. Description: Multiple airflow warm-air hand dryer, using two or more airstreams for rapid hand drying.
7. Mounting [Surface mounted]
8. Operation: Electronic-sensor activated with operation time of 20 seconds.
9. Cover Material and Finish: Stainless steel.
10. Electrical Requirements: 85-130 V at 60 Hz
11. Multiple Airflow Warm-Air Dryer:



D. Paper Towel Dispenser:
   1. *MOD* MANUAL TOUCHLESS HARD ROLL TOWEL DISPENSER, BLACK #34346 (Dispenses one 8" diameter roll of 700' or 1150' product plus stub roll utilizing core plug mounting).*
   2. Owner Furnished Contractor Installed

E. Napkin Disposal:
   1. American Specialties #0472 (partition mounted dual disposal)
   2. American Specialties #0473 (recessed mounted for side wall)
   3. American Specialties #0473-A (surface mounted for side wall)

F. Toilet Paper Dispenser:
   1. Kimberly Clark Professional Bathroom Tissue Dispenser #09551 (holds two full 9.38" diameter rolls or one standard 13" diameter roll plus stub roll).
   2. Owner Furnished Contractor Installed

G. Napkin/Tampon Vendor:
   1. American Specialties #9468 (fully recessed)
   2. American Specialties #94684 (semi-recessed)

H. Surface Mounted Soap Dispenser:
   1. GOJO LTX liquid soap dispenser, 1200mL capacity, impact resistant polymer.
   2. Owner Furnished Contractor Installed

I. Grab Bars:
   1. Bobrick B-5806 Series or equal, 18 gauge, 1 ¼" diameter

J. Framed Mirror:
   1. Bobrick B-165 series or equal, individual frames mirror with stainless steel frame. Mirror corners and back protected by shock-absorbing material.

K. Baby Changing Station:
   1. Koala *KB300* or equal with pneumatic cylinder opening device.
   2. Station can be built in counter with sink and paper towel dispenser located nearby.

Part 3 Execution

3.1 *Ordering and coordination:*

A. *Coordinate ordering of Owner furnished products at least 120 days prior to installation*

3.2 Typical Location

A. All toilet rooms.

3.3 Installation / Protection

A. Per manufacturer's recommendations, and to meet ADA requirements.

END OF SECTION 10 28 13

SECTION 10 40 00 – SAFETY SPECIALTIES

PART 1 - General

1.1 Reference Standards; NFPA 10, NFPA 10R, NFPA Fire Protection Handbook

1.2 Reference Codes; International Fire Code 2015

PART 2 - Submittals

2.1 Submit product data showing conformance with this section. Data shall include materials, finishes, installation, etc.

PART 3 - Products

3.1 Fire Extinguisher Cabinets

A. All fire extinguisher cabinets are to be recessed, or semi-recessed if wall construction does not allow for recessed cabinets. In a semi-recessed installation, cabinet shall only project 4" from the interior face of the wall.

B. All cabinets doors and trim shall be constructed of aluminum. Tub shall be constructed of cold rolled steel with powder coat white finish.

C. Cabinet doors shall be magnetic, with a vertical, clear acrylic, partial viewing window.

D. Each door shall bear label "FIRE EXTINGUISHER" in engraved lettering 2-1/4 inches high.

E. Fire extinguisher cabinets shall be installed in quantities and locations necessary to meet all local code requirements, or as requested by the authority having jurisdiction.

F. Approved manufacturers: "Academy" manufactured by J.L. Industries, Inc. or approved equal.

3.2 Fire Extinguishers

A. All fire extinguishers are to be provided, and installed based on the hazard class as defined by NFPA 10

(Standard for Portable Fire Extinguisher).

B. Dry Chemical Extinguishers. Provide a dry chemical fire extinguisher constructed of heavy-duty steel with a metal valve and siphon tube and replaceable valve stem seal. Fire extinguisher shall be UL

rated. Install with J hook wall bracket, or within fire extinguisher cabinet. Approved Manufacturer's: "Cosmic 10E" manufactured by J.L. Industries or approved equal.

C. Wet Chemical Extinguishers. Provide a wet chemical fire extinguisher constructed of stainless steel. Fire extinguisher shall be UL rated. Install with a wall bracket, or within fire extinguisher cabinet. Approved Manufacturer's: "Saturn" manufactured by J.L. Industries or approved equal.

3.3 Automated External Defibrillators (AEDs)

A. All automatic external defibrillators are to be provided, and installed based on all local code requirements.

B. "LifePak 500" by Medtronic Physio-Control, Inc., with roller reed ball contact and local alarm, or approved substitution. Signage, in the form of painted or stick-on letters, to be posted on the backside of the glass doors (to be read from the front) shall read: "Automated External Defibrillator."

C. Lifestart cabinet model 1435F12 by J.L. Industries with No.4 satin stainless steel fully recessed tub. Provide Fire-FXTM option, where installed in fire-rated walls.

PART 4 - Execution

4.1 Installation

A. Install cabinets in accord with manufacturer's printed instructions at locations shown on drawings.

4.2 Charged Fire Extinguishers

4.3 Charged fire extinguishers shall not be placed until time of substantial completion of project.

A. Place a dry chemical type extinguisher in each cabinet installed on a facility, or mount fire extinguishers to a wall bracket where shown on drawings.

4.4 Defibrillators

A. AEDs shall not be placed in cabinets until time of substantial completion of project.

B. Connect roller reed ball contact in AED cabinet with security system to provide locator signal in an area of central control where it can be monitored.

END OF SECTION 10 40 00

SECTION 10 51 13 – METAL LOCKERS

PART 1 - General

1.1 General Control

A. Use painted metal lockers with solid fronts. All lockers to have vented fronts.

PART 2 - Products

2.1 Manufacturers

A. For solid doors use standard corridor locks with double -pan, honeycomb cored door.

B. Mild cold rolled sheet steel free from surface imperfections and contaminants.

C. Continuous Hinge

2.2 Finishes

A. To be selected from manufacturer's standard finishes.

PART 3 - Execution

3.1 Typical Location

A. As required by program or educational standards such as athletics, art, etc.

3.2 Installation

A. Install per manufacturer's instructions.

3.3 Protection/ Cleaning

A. Clean per manufacturer's instructions.

END OF SECTION 10 51 13

Division 14 – Conveying Equipment

14	00	00	Elevator Checklist
14	21	00	Electric Traction Elevators
14	24	00	Hydraulic Elevators
14	24	13	Hydraulic Freight Elevator
14	42	00	Wheelchair Lift

Division 14 – Conveying Equipment

SECTION 14 00 00 – ELEVATOR CHECKLIST

PART 1 - General

1.1 Reference Standards

A. This standard provides general guidance concerning the specific preferences of Alamo Community College for elevator and escalator basic requirements.

B. Alamo Community College recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for ACCD projects.

PART 2 - Products

2.1 Alamo Community College does not have standard elevator manufacturers.

PART 3 - Execution

3.1 Elevator Checklist per ASME/ANSI A17.1

A. One smoke detector is required in each elevator lobby. Wiring from the detector is run to the elevator machine room to the elevator controller. Smoke detectors shall not be self- resetting. Primary and alternate zones for smoke detectors are required to provide the code required elevator alternate landing feature. Rule 211.3. Sprinkler required in pit of hydraulic elevators

B. Where the pit extends more than 35 in. below the door provide a Metal pit ladder is to extend from the pit floor upward, not less than 48" above the sill of the access door. One ladder per elevator is required. Rule 2.2.4

C. Pit light and switch shall be accessible and from the pit access door. The pit convenience outlet shall be a GFI and mounted 48" above the pit floor. If sprinkled, NEMA 4 electrical apparatus required below four feet.

D. Machine room to be provided with natural or mechanical ventilation to keep ambient temperature and humanity in the range specified by the elevator equipment manufacturer. 2.7.9.2

E. Fused, padlockable mainline disconnect switch in machine room with feeder wires to elevator controller, all piped in accordance with N.F.P.A. and grounded. Disconnect switch must be in sight of

the elevator machine and shall be the type that cannot be engaged with the door open. Rule 210.5. Shunt trip to be installed in disconnect or separate enclosure in the elevator machine room. A17.1 rule 102.2. If the elevator is a hydraulic type, the mainline disconnect shall have auxiliary contacts to remove power from the battery lowering unit.

F. An mergency stop switch shall not be provided on passengers elevators 2.26.2.5. A stop switch shall be provided in the pit 2.26.2.7. A stop switch shall be provited on top of car 2.26.2.8

One (1) 120 volt, 20 amp, single phase power supply, fused padlockable disconnect in machine room and run to the elevator controller for the car light supply, for each elevator.

G. Provide an ADA compliant two- way communication in the elevator cab that is hooked up to a 24-hour maintained location. 2.27.1.1. Provide a phone in the elevator machine room for communication with the elevator car. The telephones will dial 911 through the campus PBX which will need a variance.

H. Only elevator equipment is allowed in an elevator machine room. A sprinkler head is required in the machine room. There shall be a heat detector mounted within 2 feet of the sprinkler head and there shall be a smoke detector in the machine room. When hoistway and/or machine room sprinklers are provided, then an automatic disconnect for elevator power (shunt trip) must be provided. When the hoistway is sprinkled, it shall have a head and smoke detector. If the hoistway is not sprinkled, there shall not be a smoke detector in the hoistway. For hydraulic elevators, sprinkler heads are required in the pit. If the sprinkler head is no more than two feet from the pit floor, no heat detector is required. All risers and returns shall be located outside of the hoistway and machine room. Branch lines in the hoistway shall supply sprinklers at no more than one floor level.

I. Machine room doors shall be B labeled, self-closing, and self-locking that can be opened from the machine room side without a key. Keys to unlock the machine room doors shall be readily accessible to authorized personnel, but not accessible to the general public.

J. All fire sprinkler risers shall be located outside elevator hoistways.

K. Elevator hoistways shall be two (2) hour rated. Machine room (s) shall be rated for two (2) hour fire rating. There are exceptions to this rule, but it varies between areas.

L. Pit shall be so designed and sized as to prevent the entry of ground water and remain dry. A sump pump is required and the sump pump recess must have a metal grate cover that is substantially flush with the pit floor. The sump pump is to have a separate circuit with a non-GFI simplex receptacle for the pump plug-in mounted 48” above bottom of the elevator shaft floor. The motor-rated switch for controlling the sump pump is to be mounted 42” above bottom landing floor level, adjacent to the light switch. Label switch “pump”. The pump discharge piping is to be routed to a location near the pump switch. A hose bib is to be placed on the piping at this point. Valves (gate and/or check) are not required in discharge pipe; only a union is to be installed at the pump for disassembly by maintenance. The local alarm panel shall be located above pump switch (where practical), shall have

an alarm silence feature, and shall be powered from sump pump circuit at all times or other means. Switches and hose bib shall be located by ladder.

M. All machine rooms must have permanent lighting. (19 foot candles at floor). 2.7.9

N. Hoistway walls shall be substantially flush on hoistway side. Beams, floor slabs, or other building construction making an angle of 75 deg with horizontal shall not project more than 4" unless top surface of projection is beveled at 75 deg. 2.1.6.2

O. Pipes, conduits, or ducts conveying air, gases vapors, or liquids which are not used in connection with the operation of the elevator are not permitted in the hoistway or machine rooms. 2.8

P. Spaces containing machine, control equipment sheaves and other machinery shall be enclosed with fire-resistive enclosure. Enclosures and access doors thereto shall have a fir-resistance rating at least equal to that required for the hoistway enclosure. 2.7.1

Q. Grout space between floor and sill edge.

R. Patch any holes in the hoistway wall and “clip” all screws or other items projecting into elevator shaft.

S. Refuge space between top of care and structure is to be 43” minimum. 2.4.7

T. Hoistways shall have floor numbers, not less than 4" in height on the hoistway side of the enclosure or hoistway doors. 2.29.2

U. Hall button wires to be in conduit.

V. When required by the building code, hoistways shall be provided with means to prevent accumulation of smoke and hot gases. 2.1.4

W. All hall button covers to have Appendix “H” pictograph with words: “In case of fire, elevators are out of service. Use exit”. UBC 3003.6.

X. Verify with elevator consultant and structural engineer for structural requirements. Including, but not limited to, pit floor loading, erection hoist beam and guide rail supports.

Y. Verify with current code for fire rating of elevator shaft.

Z. Verify side clearance and determine if handrails are need on top of car.

AA. Hose Bibs are required in elevator pits.

3.2 ADA/TAS

A. Elevators to meet all ADA and TAS requirements. Refer to ADA and TAS guidelines for elevator and clearance requirements

END OF SECTION 14 00 00

Division 14 – Conveying Equipment

SECTION 14 21 00 – ELECTRIC TRACTION ELEVATORS

PART 1 - General

1.1 Reference Standards

A. This standard provides general guidance concerning the specific preferences of Alamo Community College for elevator and escalator basic requirements.

B. Alamo Community College recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for ACCD projects.

1.2 Quality Control

A. American Architectural Manufacturers Association (AAMA)
   1. AAMA 607.1 Voluntary Guide specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

B. American Society of Mechanical Engineers (ASME)
   1. A17.1 Safety Code for Elevators
   2. A17.2.2 Inspector's Manual for Elevators American Plywood Association (APA)

C. American Society for Testing and Materials (ASTM)

D. National Electrical Manufacturer's Association (NEMA)

E. National Fire Protection Association (NFPA)
   1. NFPA 70 National Electrical Code
   2. NFPA 80 Fire Rated Doors and Windows

F. Americans with Disabilities Act

G. MIL-L-1914: Lumber and Plywood, Fire Retardant Treatment AWS D1.1: Structural Welding Code

H. AISC-Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings

I. ANSI/IEEE 519: Electrical harmonic requirements

J. Cab and clearances to meet ADA and TAS requirements.

1.3 System Description

A. An Electric Elevator is a power elevator where the energy is applied by means of an electric driving machine. The machine includes the motor, brake, and the driving sheave or drum together with its connecting gearing.

B. For buildings with up to 27 floors, a pre-engineered geared traction elevators are the most effective. These elevators are available in load capacities from 2,100 to 5,000 pounds and speeds from 200 to 500 feet-per-minute.

C. A gearless elevator provide high speed service for any number of floors for capacities from 2500 to 4000 lbs. and speeds of 500 feet per minute and beyond.

1.4 Specifications to include

1. Type: Electric geared traction. (top mounted machine room or offset mounted machine room.)
2. Control: Microprocessor based static type that is software oriented.
3. Electrical Power: For elevator drive equipments: HP, 480 Volt, three-phase 60Hz. For lighting: 120 Volt, 60 Hz.
4. Drive System: Variable voltage variable frequency (VVVF)
5. Rated Net Capacity: lbs.
6. Rated Speed: ft/min.
7. Car Interior Dimensions
8. Cab Height
9. Cab Clear Ht. to suspended ceiling
10. Hoistway and Cab Entrance Frame opening size
11. Door Type/Operation: center opening, single slide; center opening, two speed; single slide; single slide, two speed
12. No. of Stops: Number of stops; travel distance.
13. No. of Openings: Number; Number at front and number at rear.

1.5 Operations

A. Select one of the following:

1. Simplex Collective
2. Duplex Collective
3. Group microprocessor controlled demand allocation

PART 2 - Products

2.1 Manufacturers

A. Equivalent products by the following are acceptable
1. hyssen rupp
2. KONE
3. Tejas Elevators
4. United Technologies Otis Elevator Company
5. Schindler Elevator Corporation
6. Motion Control Engineering Inc.
7. Owner Approved Equal

2.2 Materials

A. Steel
1. Shapes: ASTM A36
2. Sheet: ASTM A446, galvanized, stretcher leveled, Commercial Grade

B. Stainless Steel: ASTM A167, Type 302 or 304

C. Aluminum: Anodizing Quality
1. Extrusions: ASTM B221
2. Sheet: ASTM B209, alloy 6063

D. Solid Surface: ISSFA-2

E. Paints
1. Primer for Steel: Red Oxide (no lead).
2. Primer for Wood: Alkyd primer/sealer.
3. Enamel: Semi-gloss alkyd

2.3 Cab design
1. Flooring: Rubber flooring or aluminum checkered plate, ¼" thick. Architect to specify the "finish" floor. "Finish" floor materials to be rubber flooring, ceramic tile, slate, etc. VCT and carpet are not acceptable "finish" floor materials.
2. Sides and rear walls: Solid Surface
3. Handrails: Stainless steel, cylindrical profile
4. Front and rear returns and transom: Stainless steel with No. 4 finish.
5. Ceiling: Translucent suspended specified distance under ceiling.
6. Canopy: Baked enamel on steel specified distance under canopy.
7. Ventilation: 2 speed blower mounted above ceiling, with grille.

8. Lighting: Fluorescent with solid lens diffuser.
9. Provide wall hooks and removable protective mats for cab walls.
10. Provide stainless steel license holders for display of required certificates. Design the holder to used non-visible tamper- proof fastenings. Holder shall enclose an 8 ½" x 11" sign.

PART 3 - Execution

3.1 Installation

A. Install in accordance with ASME A17.1, manufacturer's instructions, and applicable codes. Coordinate with elevator consultants and structural engineer for structural requirements.

B. Check code for fire rating of shaft

END OF SECTION 14 21 00

Division 14 – Conveying Equipment

SECTION 14 24 00 – HYDRAULIC ELEVATORS

PART 1 - General

1.1 Reference Standards

Quality Control

A. American Architectural Manufacturers Association (AAMA)
   1. AAMA 607.1 Voluntary Guide specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

B. American Society of Mechanical Engineers (ASME)
   1. A17.1 Safety Code for Elevators
   2. A17.2.2 Inspector's Manual for Elevators American Plywood Association (APA)

C. American Society for Testing and Materials (ASTM)

D. National Electrical Manufacturer's Association (NEMA)

E. National Fire Protection Association (NFPA)
   1. NFPA 70 National Electrical Code
   2. NFPA 80 Fire Rated Doors and Windows

F. Americans with Disabilities Act

G. MIL-L-1914: Lumber and Plywood, Fire Retardant Treatment AWS D1.1: Structural Welding Code

H. AISC-Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings

I. ANSI/IEEE 519: Electrical harmonic requirements

J. Cab and clearances to meet ADA and TAS requirements.

1.2 System Description

A. The Hydraulic Elevator uses an oil hydraulic driving machine to raise and lower the elevator car and its load. A hydraulic pump unit is one in which the energy is applied by means of a liquid pressure in a cylinder equipped with a plunger or piston. The car is supported at the pit floor. Lower speeds and

the piston length restrict the use of this system to approximately 55 feet. It generally requires the least initial installation expense, but more power is used during operation because the greater loads imposed on the driving machine.

1.3 Specifications to include:

1. Type: Hydraulic. Holed, holeless telescoping or holeless.
2. Control: Microprocessor based static type that is software oriented.
3. Electrical Power: For elevator drive equipments: HP, 480 Volt, three-phase 60Hz. For lighting: 120 Volt, 60 Hz.
4. Rated Net Capacity: 2000-5000 lbs.
5. Rated Speed: 80-200 ft/min.
6. Car Interior Dimensions: varies with model
7. Cab Height: 8'- 0"
8. Door Height: 7'-0"
9. Cab Clear Ht. to suspended ceiling: highest possible
10. Hoistway and Cab Entrance Frame opening size: min. 36"
11. Door Type/Operation: single slide.
12. No. of Stops: Number of stops; travel distance. Typically seven or less for Hydrolic. Holeless Hydrolic will have four or less.
13. No. of Openings: Number; Number at front and number at rear. This depends on the building.

1.4 Operation

1. Simplex Collective

PART 2 - Products

2.1 Manufacturers

A. Equivalent products by the following are acceptable.

1. Hyssen Rupp
2. KONE
3. Tejas Elevators
4. United Technologies Otis Elevator Company
5. Schindler Elevator Corporation
6. Owner Approved Equal

2.2 Materials

A. Steel
1. Shapes: ASTM A36
2. Sheet: ASTM A446, galvanized, stretcher leveled, Commercial Grade

B. Stainless Steel: ASTM A167, Type 302 or 304

C. Aluminum: Anodizing Quality
1. Extrusions: ASTM B221
2. Sheet: ASTM B209, alloy 6063

D. Solid Surface: ISSFA-2

E. Paints
1. Primer for Steel: Red Oxide (no lead).
2. Primer for Wood: Alkyd primer/sealer.
3. Enamel: Semigloss alkyd

2.3 Cab Design

1. Flooring: Rubber flooring or aluminum checkered plate, ¼" thick. Architect to specify the "finish" floor. "Finish" floor materials to be rubber flooring, ceramic tile, slate, etc. VCT and carpet are not acceptable "finish" floor materials.
2. Sides and rear walls: Solid Surface
3. Handrails: Stainless steel, cylindrical profile
4. Front and rear returns and transom: Stainless steel with No. 4 finish.
5. Ceiling: Translucent suspended specified distance under ceiling.
6. Canopy: Baked enamel on steel specified distance under canopy.
7. Ventilation: 2 speed blower mounted above ceiling, with grille.
8. Lighting: Fluorescent with solid lens diffuser. Standard light fixtures that are easily changed out.
9. Provide wall hooks and removable protective mats for cab walls.
10. Provide stainless steel license holders for display of required certificates. Design the holder to used non-visible tamper- proof fastenings. Holder shall enclose an 8 ½" x 11" sign.

PART 3 - Execution

A. Installation

Install in accordance with ASME A17.1, manufacturer's instructions, and applicable codes.

Coordinate with elevator consultants and structural engineer for structural requirements.

Check code for fire rating of shaft.

END OF SECTION 14 24 00

Division 14 – Conveying Equipment

SECTION 14 24 13 – HYDRAULIC FREIGHT ELEVATORS

PART 1 - General

1.1 Reference Standards

A. American Architectural Manufacturers Association (AAMA)
   1. AAMA 607.1 Voluntary Guide specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

B. American Society of Mechanical Engineers(ASME)
   1. A17.1 Safety Code for Elevators
   2. A17.2.2 Inspector's Manual for Elevators

C. American Society for Testing and Materials (ASTM)

D. National Electrical Manufacturer's Association (NEMA)

E. National Fire Protection Association (NFPA)
   1. NFPA 70 National Electrical Code
   2. NFPA 80 Fire Rated Doors and Windows

F. Americans with Disabilities Act

G. MIL-L-1914: Lumber and Plywood, Fire Retardant Treatment AWS D1.1: Structural Welding Code

H. AISC-Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings

I. ANSI/IEEE 519: Electrical harmonic requirements

J. Cab and clearances to meet ADA and TAS requirements.

1.2 System Description

A. Load Classifications

B. Class A

General freight loading. Where the load is distributed, the weight of any single piece is not more than ¼ the capacity of the elevator, and the load is handled on and off the car platform manually or by means of hand trucks.

C. Class B

Motor vehicle loading. The freight elevator is used solely to carry automobile trucks or passenger automobiles up to the rated capacity of the elevator.

D. Class C1

Industrial truck loading. A four wheeled vehicle may be used to load and unload the elevator. The combined weight of the vehicle and the load cannot exceed the rated capacity and may be rolled onto the platform as a single unit.

E. Class C2

Industrial truck loading. During loading and unloading, max load on the platform may be up to 150% of the rated capacity. This enables you to use a forklift to load a car with freight weighing up to the rated capacity.

F. Class C3

Other forms of industrial truck loading. During the loading and unloading process, the rated capacity must never be exceeded.

G. Elevator Specifications to include:

1. Control: Microprocessor based static type that is software oriented.
2. Type: Hydraulic.
3. Operation: Single Automatic Push Button. This application involves a bank of pushbuttons that are mounted in a car station. A time-delay prevents the car from being dispatched to another landing, and an "In Use" light will illuminate to show the elevator is being used.
4. Electrical Power: For elevator drive equipment's: HP, 480 Volt, three-phase 60Hz. For lighting: 120 Volt, 60 Hz.
5. Rated Net Capacity: lbs.
6. Rated Speed: ft/min.
7. Loading Class: "A" or other
8. Car Interior Dimensions – width x height x depth
9. Landing entrances:
    a. Size
    b. Type: vertical bi-parting, power operated
    c. Construction: welded type
    d. Material: steel prime and painted
    e. Truckable sill on lower panel
    f. No. of Stops: Number of stops; travel distance.
    g. No. of Openings: Number; Number at front and number at rear.

1.3 Operations

1. Simplex Collective
2. Duplex Collective

PART 2 - Products

2.1 Manufacturers

A. Equivalent products by the following are acceptable.
1. hyssen rupp
2. KONE
3. Tejas Elevators
4. United Technologies Otis Elevator Company
5. Schindler Elevator Corporation
6. Owner Approved Equal

2.2 Materials

A. Steel
1. Shapes: ASTM A36
2. Sheet: ASTM A446, galvanized, stretcher leveled, Commercial Grade

B. Stainless Steel: ASTM A167, Type 302 or 304

C. Aluminum: Anodizing Quality
1. Extrusions: ASTM B221
2. Sheet: ASTM B209, alloy 6063

D. Plastic Laminate: NEMA LD-3, General Purpose Type

2.3 Cab Design
1. Flooring: Rubber flooring or non-skid steel plate platform.
2. Sides and rear walls: 14 Gauge steel panels that reach the full car height.
3. Handrails: Stainless steel, cylindrical profile on rear wall.
4. Front and rear returns and transom: Stainless steel with No. 4 finish.
5. Ceiling: Highest possible ceiling height - 9'-0" minimum. Translucent suspended specified distance under ceiling.
6. Canopy: Baked enamel on steel specified distance under canopy.
7. Ventilation: 2 speed blower mounted above ceiling, with grille.
8. Lighting: Fluorescent with solid lens diffuser.
9. Provide wall hooks and removable protective mats for cab walls.
10. Provide stainless steel license holders for display of required certificates. Design the holder to used non-visible tamper- proof fastenings. Holder shall enclose an 8 ½" x 11" sign.

PART 3 - Execution

3.1 Installation

A. Install in accordance with ASME A17.1, manufacturer's instructions, and applicable codes.

B. Coordinate with elevator consultants and structural engineer for structural requirements.

C. Check code for fire rating of shaft.

END OF SECTION 14 24 13

Division 14 – Conveying Equipment

SECTION 14 42 00 – WHEELCHAIR LIFT

PART 1 - General

1.1 Reference Standards

A. Reference Standards

This standard provides general guidance concerning the specific preferences of Alamo Community College for wheelchair lift basic requirements.

1.2 Quality Control

1. ANSI/ASME B20.1/ASME A17.1 Safety Standard for Conveyor and Related Equipment
2. IEEE C1 – National Electrical Safety Code
3. State of Texas Accessibility Standards
4. ANSI 117.1 Accessibility Requirements
5. ANSI A18.1 – Wheelchair lifts

B. Wheelchair lifts should only be installed if a ramp cannot be configured to meet accessibility requirements. Lift to meet ADA and TAS requirements.

PART 2 - Products

2.1 Manufacturers

A. Equivalent products by the following are acceptable.

1. AmeriGlide
2. Harmar
3. Owner Approved Equal

2.2 System Description

1. Rated Load: 450 lbs.
2. Rated Speed: 20 fpm
3. Suspension: Rack and pinion.

Part 3 Execution

2.3 Installation

A. Install in accordance with ASME A17.1, ASME B20.1, AWS D1.1, IEEE C1, manufacturer's instructions, and applicable codes.

END OF SECTION 14 42 00

Division 21 – Fire Suppression

21 11 00 Fire Suppression Standpipes
21 13 13 Wet Pipe Sprinkler Systems
21 13 16 Dry Pipe Sprinkler Systems
21 22 00 Clean-Agent Fire-Extinguishing Systems

SECTION 21 11 00 – FIRE SUPPRESSION STANDPIPES

PART 1 - General

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Hose stations.
5. Fire-department connections.
6. Alarm devices.
7. Control panels.
8. Pressure gages.

B. Related Sections:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 212200 "Clean Agent Fire Extinguishing Systems" for AFFF piping.
4. Section 283111 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 Definitions

A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

1.4 System Descriptions

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

B. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.

C. Semiautomatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve and deluge valve with standpipes containing air. Actuation of detection device permits water pressure to open deluge valve. Water then flows into standpipes.

D. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.

E. Manual Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

1.5 Performance Requirements

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. High-Pressure, Fire-Suppression Standpipe System Component: Listed for 250-psig minimum working pressure.

C. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   1. Available fire-hydrant flow test records indicate the following conditions:
      a. Date:
      b. Time:
      c. Performed by:
      d. Location of Residual Fire Hydrant R:
      e. Location of Flow Fire Hydrant F:
      f. Static Pressure at Residual Fire Hydrant R:
      g. Measured Flow at Flow Fire Hydrant F:
      h. Residual Pressure at Residual Fire Hydrant R

D. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
   1. Minimum residual pressure at each hose-connection outlet is as follows:
      a. NPS 2-1/2 Hose Connections
   2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
      a. NPS 2-1/2 Hose Connections

E. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 Action Submittals

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 Information Submittals

A. A. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. All other piping systems.

B. B. Qualification Data: For qualified installer and professional engineer.

C. C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. D. Welding certificates.

E. E. Fire-hydrant flow test report.

F. F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

G. G. Field quality-control reports.

1.8 Close out

A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.9 Quality Assurance

A. A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

1.10 Project Conditions

A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:
   1. Notify owner no fewer than two days in advance of proposed interruption of fire- suppression standpipe service.
   2. Do not proceed with interruption of fire-suppression standpipe service without owner's written permission.

PART 2 - Products

2.1 Piping Materials

A. Comply with requirements in the International Fire Code 2015 for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 Steel Pipe and Fittings

A. Standard Weight, Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Standard-Weight, Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.

D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860. NPS 2 and smaller.

G. Cast-Iron Flanges: ASME B16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. Anvil International, Inc.
      b. Corcoran Piping System Co.
      c. National Fittings, Inc.
      d. Shurjoint Piping Products.
      e. Tyco Fire & Building Products LP.
      f. Victaulic Company.
   2. Pressure Rating: 175 psig minimum.
   3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 Piping Joining Materials

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 Listed Fire-Protection Valves

A. General Requirements:
1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Anvil International, Inc.
   b. Victaulic Company.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3 and larger: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Fivalco Inc.
   b. Global Safety Products, Inc.
   c. Milwaukee Valve Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.

e. Milwaukee Valve Company.
f. NIBCO INC.
g. Pratt, Henry Company.
h. Shurjoint Piping Products.
i. Tyco Fire & Building Products LP.
j. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves.
   f. Crane Co.; Crane Valve Group; Jenkins Valves.
   g. Crane Co.; Crane Valve Group; Stockham Division.
   h. Fire-End & Croker Corporation.
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation.
   l. Groeniger & Company.
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca.
   o. Metraflex, Inc.
   p. Milwaukee Valve Company.
   q. Mueller Co.; Water Products Division.
   r. NIBCO INC.
   s. Potter Roemer.
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products.
   v. Tyco Fire & Building Products LP.
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.
   y. Victaulic Company.
   z. Viking Corporation.
   aa. Watts Water Technologies, Inc.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.

4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Shurjoint Piping Products.
   l. Tyco Fire & Building Products LP.
   m. United Brass Works, Inc.
   n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Anvil International, Inc.
   b. Fivalco Inc.

c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Shurjoint Piping Products.
h. Tyco Fire & Building Products LP.
i. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch and visual indicating device.

I. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum .
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

J. Indicator Posts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.

e. Kennedy Valve; a division of McWane, Inc.
f. Mueller Co.; Water Products Division.
g. NIBCO INC.
h. Tyco Fire & Building Products LP.

2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

2.5 Trim and Drain Valves

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. Affiliated Distributors.
b. Anvil International, Inc.
c. Barnett.
d. Conbraco Industries, Inc.; Apollo Valves.
e. Fire-End & Croker Corporation.
f. Fire Protection Products, Inc.
g. Flowserve.
h. FNW.
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation.
l. Legend Valve.
m. Metso Automation USA Inc.
n. Milwaukee Valve Company.
o. NIBCO INC.
p. Potter Roemer.
q. Red-White Valve Corporation.
r. Southern Manufacturing Group.

s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

E. Plug Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. Southern Manufacturing Group.

2.6 Specialty Valves

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. AFAC Inc.
b. Globe Fire Sprinkler Corporation.
c. Reliable Automatic Sprinkler Co., Inc.
d. Tyco Fire & Building Products LP.
e. Venus Fire Protection Ltd.
f. Victaulic Company.
g. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

5. Drip Cup Assembly with Retarding Chamber: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly without Retarding Chamber: Pipe drain with check valve to main drain piping.

C. Dry-Pipe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
2. Standard: UL 260.
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      1) AFAC Inc.
      2) Globe Fire Sprinkler Corporation.
      3) Reliable Automatic Sprinkler Co., Inc.
      4) Tyco Fire & Building Products LP.
      5) Venus Fire Protection Ltd.
      6) Victaulic Company.
      7) Viking Corporation.
   b. Standard: UL 260.
   c. Type: Automatic device to maintain minimum air pressure in piping.
   d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
6. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc.
      3) Viking Corporation.
      4) Standard: UL's "Fire Protection Equipment Directory" listing.
      5) Motor Horsepower: Fractional.

6) Power: 120-V ac, 60 Hz, single phase.

D. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. BERMAD Control Valves.
   c. CLA-VAL Automatic Control Valves.
   d. Globe Fire Sprinkler Corporation.
   e. OCV Control Valves.
   f. Reliable Automatic Sprinkler Co., Inc.
   g. Tyco Fire & Building Products LP.
   h. Venus Fire Protection Ltd.
   i. Victaulic Company.
   j. Viking Corporation.
2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
6. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air- pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
7. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      1) AFAC Inc.
      2) Globe Fire Sprinkler Corporation.
      3) Reliable Automatic Sprinkler Co., Inc.
      4) Tyco Fire & Building Products LP.
      5) Venus Fire Protection Ltd.
      6) Victaulic Company.
      7) Viking Corporation.
   b. Standard: UL 260.
   c. Type: Automatic device to maintain minimum air pressure in piping.
   d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator, or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

8. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc.
      3) Viking Corporation.
   b. Standard: UL's "Fire Protection Equipment Directory" listing.
   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.

E. Pressure-Reducing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. AFAC Inc.
      b. Elkhart Brass Mfg. Company, Inc.
      c. Fire-End & Croker Corporation.
      d. Fire Protection Products, Inc.
      e. GMR International Equipment Corporation.
      f. Guardian Fire Equipment, Inc.
      g. Potter Roemer.
      h. Tyco Fire & Building Products LP.
      i. Wilson & Cousins Inc.
      j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
   2. UL 668 hose valve, with integral UL 1468 reducing device.
   3. Pressure Rating: 300 psig minimum.
   4. Material: Brass or bronze.
   5. Inlet: Female pipe threads.
   6. Outlet: Threaded with or without adapter having male hose threads.
   7. Pattern: Gate.
   8. Finish: Rough brass or bronze.

F. Automatic (Ball Drip) Drain Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. AFAC Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
   2. Standard: UL 1726.
   3. Pressure Rating: 175 psig minimum.
   4. Type: Automatic draining, ball check.
   5. Size: NPS 3/4.
   6. End Connections: Threaded.

2.7 Hose Connections

A. Adjustable-Valve Hose Connections:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Potter Roemer.
   h. Tyco Fire & Building Products LP.
   i. Wilson & Cousins Inc.
   j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Gate.
9. Pressure-Control Device Type: Pressure reducing.
10. Design Outlet Pressure Setting:
11. Finish: Rough brass or bronze.

B. Nonadjustable-Valve Hose Connections:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Kennedy Valve; a division of McWane, Inc.
   h. Mueller Co.; Water Products Division.
   i. NIBCO INC.
   j. Potter Roemer.
   k. Tyco Fire & Building Products LP.
   l. Wilson & Cousins Inc.
2. Standard: UL 668 hose valve for connecting fire hose.

3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Gate.
9. Finish: Rough brass or bronze.

2.8 Fire Department Connections

A. Exposed-Type, Fire-Department Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Tyco Fire & Building Products LP.
   h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Three.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE"
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 4, NPS 5, NPS 6.

B. Flush-Type, Fire-Department Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. GMR International Equipment Corporation.

d. Guardian Fire Equipment, Inc.
e. Potter Roemer.

2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Three.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4, NPS 5, NPS 6, NPS 8.

C. Yard-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Three.
11. Sleeve: Brass.
12. Sleeve Height: 18 inches.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish Including Sleeve: Polished chrome plated.

15. Outlet Size: NPS 4, NPS 5, NPS 6.

2.9 Alarm Devises

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 8-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Viking Corporation.
   f. Watts Industries (Canada) Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.

4. Components: Two single-pole, double-throw circuit switches for 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 if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. AFAC Inc.
   b. Barksdale, Inc.
   c. Detroit Switch, Inc.
   d. Potter Electric Signal Company.
   e. System Sensor; a Honeywell company.
   f. Tyco Fire & Building Products LP.
   g. United Electric Controls Co.
   h. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.10 Control Panel

A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.11 Pressure Gages

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. AMETEK; U.S. Gauge Division.
2. Ashcroft Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - Execution

3.1 Preparation

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 Examination

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 Service Entrance Piping

A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water- Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.4 Water Supply Connections

A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 221119 "Domestic Water Piping Specialties."

3.5 Piping Installation

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

G. Install alarm devices in piping systems.

H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

J. Drain dry-type standpipe system piping.

K. Pressurize and check dry-type standpipe system piping and air-pressure maintenance devices.

L. Fill wet-type standpipe system piping with water.

M. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

N. Connect compressed-air supply to dry-pipe sprinkler piping.

O. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping.".

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.6 Joint Construction

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized- steel pipe.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.7 Valve Specialties Installation

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.
   3. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      a. Install air compressor and compressed-air supply piping.
      b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
      c. Install compressed-air supply piping from building's compressed-air piping system.

3.8 Hose-Connection Installation

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

D. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Extinguisher Cabinets."

3.9 Hose–Station Installation

A. Install freestanding hose stations for access and minimum passage restriction.

B. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device unless otherwise indicated.

C. Install freestanding hose stations with support or bracket attached to standpipe.

3.10 Monitor Installation

A. Install monitors on standpipe piping.

3.11 Fire-Department Connection Intallation

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
   1. Install three protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.12 Identification

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.13 Field Quality Control

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 Demonstration

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.15 Piping Schedule

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Standard-pressure wet-type, fire-suppression standpipe piping, NPS 2 and smaller, shall be the following:

C. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 2-1/2 and larger, shall be one of the following:

D. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 2 and smaller, shall be the following:

E. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 2 and larger , shall be one of the following:

END OF SECTION 21 11 00

SECTION 21 13 13 – WET PIPES SPRINKLER SYSTEMS

PART 1 - General

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

A. Section Includes
1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Sections:
1. Section 21 Section "Fire-Suppression Standpipes" for standpipe piping.
2. Section 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Section 212200 "Clean Agent Fire Extinguishing Systems" for AFFF piping.
4. Section 283111 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 Definitions

A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 System Descriptions

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when

they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

1.5 Performance Requirements

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. High-Pressure Piping System Component: Listed for 250-psig working pressure.

C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   1. Available fire-hydrant flow test records indicate the following conditions:
      a. Date:
      b. Time:
      c. Performed by:
      d. Location of Residual Fire Hydrant R:
      e. Location of Flow Fire Hydrant F:
      f. Static Pressure at Residual Fire Hydrant R:
      g. Measured Flow at Flow Fire Hydrant F:
      h. Residual Pressure at Residual Fire Hydrant R:

D. Sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications:
      a. Automobile Parking Areas: Ordinary Hazard, Group 1
      b. Building Service Areas: Ordinary Hazard, Group 1
      c. Electrical Equipment Rooms: Ordinary Hazard, Group 1
      d. General Storage Areas: Ordinary Hazard, Group 1
      e. Laundries: Ordinary Hazard, Group 1
      f. Libraries except Stack Areas: Light Hazard
      g. Library Stack Areas: Ordinary Hazard, Group 2
      h. Machine Shops: Ordinary Hazard, Group 2
      i. Mechanical Equipment Rooms: Ordinary Hazard, Group 1
      j. Office and Public Areas: Light Hazard
      k. Repair Garages: Ordinary Hazard, Group 2
      l. Residential Living Areas: Light Hazard
      m. Restaurant Service Areas: Ordinary Hazard, Group 1
   3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft area.
d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
e. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
f. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
g. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Minimum Density for Deluge-Sprinkler Piping Design:
   a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.
   b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over entire area.
   c. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over entire area.
   d. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over entire area.
   e. Special Occupancy Hazard: As determined by authorities having jurisdiction.
5. Maximum Protection Area per Sprinkler: Per UL listing.
6. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 120 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
7. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm for 30 minutes
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
   c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes

E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7

1.6 Action Submittals

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 Informational Submittals

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Fire-hydrant flow test report.

F. F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

G. G. Field quality-control reports.

1.8 Closeout Submittals

A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.9 Quality Assurance

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.10 Protection Conditions

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify owner no fewer than two days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without owner's written permission.

1.11 Coordination

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.12 EXTRA MATERIAL

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - Products

2.1 Piping Materials

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting

B. materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 Steel Pipe and Fitting

A. Standard Weight, Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Black Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

D. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

E. Galvanized, Steel Couplings: ASTM A 865, threaded.

F. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

G. Malleable- or Ductile-Iron Unions: UL 860.

H. Cast-Iron Flanges: ASME 16.1, Class 125.

I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

K. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
    a. Anvil International, Inc.
    b. Corcoran Piping System Co.
    c. National Fittings, Inc.
    d. Shurjoint Piping Products.
    e. Tyco Fire & Building Products LP.
    f. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

L. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
      a. Victaulic Company.

2.3 Piping Joining Materials

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 Cover System for Sprinkler Piping

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   1. DecoShield Systems, Inc., or approved equal.

B. Description: System of support brackets and covers made to protect sprinkler piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.5 Listed Fire Protection Valves

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
   3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Anvil International, Inc.
      b. Victaulic Company.
   3. Standard: UL 1091 except with ball instead of disc.
   4. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   5. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   6. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
      a. Fivalco Inc.
      b. Global Safety Products, Inc.
      c. Milwaukee Valve Company.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig.
   4. Body Material: Bronze.
   5. End Connections: Threaded.

D. Iron Butterfly Valves:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Anvil International, Inc.
      b. Fivalco Inc.
      c. Global Safety Products, Inc.
      d. Kennedy Valve; a division of McWane, Inc.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Pratt, Henry Company.
      h. Shurjoint Piping Products.
      i. Tyco Fire & Building Products LP.
      j. Victaulic Company.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig.
   4. Body Material: Cast or ductile iron.
   5. Style: Lug or wafer.
   6. End Connections: Grooved.

E. Check Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves.
   f. Crane Co.; Crane Valve Group; Jenkins Valves.
   g. Crane Co.; Crane Valve Group; Stockham Division.
   h. Fire-End & Croker Corporation.
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation.
   l. Groeniger & Company.
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca.
   o. Metraflex, Inc.
   p. Milwaukee Valve Company.
   q. Mueller Co.; Water Products Division.
   r. NIBCO INC.
   s. Potter Roemer.
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products.
   v. Tyco Fire & Building Products LP.
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.
   y. Victaulic Company.
   z. Viking Corporation.
   aa. aa. Watts Water Technologies, Inc.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.
2. Standard: UL 262.

3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Shurjoint Piping Products.
   l. Tyco Fire & Building Products LP.
   m. United Brass Works, Inc.
   n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Shurjoint Piping Products.
   h. Tyco Fire & Building Products LP.
   i. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
   a. End Connections: Flanged or grooved.

J. Indicator Posts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Tyco Fire & Building Products LP.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

2.6 Trim and Drain Valves

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Affiliated Distributors.
   b. Anvil International, Inc.
   c. Barnett.
   d. Conbraco Industries, Inc.; Apollo Valves.
   e. Fire-End & Croker Corporation.
   f. Fire Protection Products, Inc.
   g. Flowserve.
   h. FNW.
   i. Jomar International, Ltd.
   j. Kennedy Valve; a division of McWane, Inc.
   k. Kitz Corporation.
   l. Legend Valve.
   m. Metso Automation USA Inc.
   n. Milwaukee Valve Company.
   o. NIBCO INC.
   p. Potter Roemer.
   q. Red-White Valve Corporation.
   r. Southern Manufacturing Group.
   s. Stewart, M. A. and Sons Ltd.
   t. Tyco Fire & Building Products LP.
   u. Victaulic Company.
   v. Watts Water Technologies, Inc.

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   a. Southern Manufacturing Group.

2.7 Specialty Valves

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
   b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Deluge Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. BERMAD Control Valves.
   c. CLA-VAL Automatic Control Valves.
   d. Globe Fire Sprinkler Corporation.
   e. OCV Control Valves.
   f. Reliable Automatic Sprinkler Co., Inc.
   g. Tyco Fire & Building Products LP.

h. Venus Fire Protection Ltd.
i. Victaulic Company.
j. Viking Corporation.

2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.

D. Automatic (Ball Drip) Drain Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.8 Fire Department Connextions

A. Exposed-Type, Fire-Department Connection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Tyco Fire & Building Products LP.
   h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Three.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 4, NPS 5, NPS 6.

B. Flush-Type, Fire-Department Connection:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Three.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4, NPS 5, NPS 6, NPS 8.

C. Yard-Type, Fire-Department Connection:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Wilson & Cousins Inc.
2. Standard: UL 405.

3. Type: Exposed, freestanding.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Three.
11. Sleeve: Brass.
12. Sleeve Height: 18 inches.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish Including Sleeve: Polished chrome plated
15. Outlet Size: NPS 4, NPS 5, NPS 6.

2.9 Sprinkler Specialty Pipe Fitting

A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
   a. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Shurjoint Piping Products.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
   f. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   g. Pressure Rating: 175 psig minimum.
   h. Body Material: Cast- or ductile-iron housing with sight glass.
   i. Size: Same as connected piping.
   j. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.

4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler

2.10 Sprinklers

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:
   a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
   b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.

E. Sprinkler Finishes:
1. Chrome plated.
2. Painted.

F. Special Coatings:
1. Wax.
2. Lead.
3. Corrosion-resistant paint.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

H. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.11 Alarm Devices

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.

7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 8-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Viking Corporation.
   f. Watts Industries (Canada) Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for 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 if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Barksdale, Inc.
   c. Detroit Switch, Inc.
   d. Potter Electric Signal Company.
   e. System Sensor; a Honeywell company.
   f. Tyco Fire & Building Products LP.
   g. United Electric Controls Co.
   h. Viking Corporation.
2. Standard: UL 346.

3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.12 Manual Control Stations

A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.13 Control Panels

A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.14 Pressure Gases

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - Execution

3.1 Preparation

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 Service Entrance Piping

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.3 Water Supply Connections

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

3.4 Piping Installation

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS ¼ and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices.

O. Fill sprinkler system piping with water.

P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

3.5 Joint Construction

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized- steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 Installation of Cover System for Sprinkler Piping

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.7 Valve and Specialties Installation

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.8 Sprinklers Installation

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet- type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.9 Fire Department Connection Installation

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete."
1. Install three protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications."

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 Identification

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 Field Quality Control

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 Cleaning

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.13 Demonstration

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.14 Piping Schedule

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Standard-weight, black-steel pipe with roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

G. High-pressure, wet-pipe sprinkler system, NPS 4 and smaller, shall be one of the following:
1. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

H. High-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:
1. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.15 Sprinkler Schedule

A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers
2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent, and Sidewall sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

SECTION 21 13 16 – DRY PIPE SPRINKLER SYSTEMS

PART 1 - General

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section:

1.2 Summary

A. Section Includes:
1. Fire-protection valves.
2. Fire-department connections.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Sections
1. Section 21 1200, FIRE-SUPPRESSION STANDPIPES for standpipe piping.
2. Section 21 1313, WET-PIPE SPRINKLER SYSTEMS for wet-pipe sprinkler piping.
3. Section "28 3111, DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM for alarm devices not specified in this Section.

1.3 Definitions

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.4 System Description

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices

that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.

C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.

D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

1.5 Performance Requirements

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   1. Available fire-hydrant flow test records indicate the following conditions:
      a. Date:
      b. Time:
      c. Performed by:
      d. Location of Residual Fire Hydrant R:
      e. Location of Flow Fire Hydrant F:
      f. Static Pressure at Residual Fire Hydrant R:
      g. Measured Flow at Flow Fire Hydrant F:
      h. Residual Pressure at Residual Fire Hydrant R

C. Sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications:
      a. Automobile Parking Areas: Ordinary Hazard, Group 1.
      b. Building Service Areas: Ordinary Hazard, Group 1.
      c. Churches: Light Hazard.
      d. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      e. Dry Cleaners: Ordinary Hazard, Group 2.
      f. General Storage Areas: Ordinary Hazard, Group 1.
      g. Laundries: Ordinary Hazard, Group 1.
      h. Libraries except Stack Areas: Light Hazard.
      i. Library Stack Areas: Ordinary Hazard, Group 2.
      j. Machine Shops: Ordinary Hazard, Group 2.
      k. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.

l. Office and Public Areas: Light Hazard.
m. Plastics Processing Areas: Extra Hazard, Group 2.
n. Printing Plants: Extra Hazard, Group 1.
o. Repair Garages: Ordinary Hazard, Group 2.
p. Restaurant Service Areas: Ordinary Hazard, Group 1.
q. Solvent Cleaning Areas: Extra Hazard, Group 2.
r. Upholstering Plants: Extra Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
   d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
   e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
   f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
   c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 Submittals

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.

E. Qualification Data: For qualified Installer and professional engineer.

F. F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

G. G. Fire-hydrant flow test report.

H. H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

I. I. Field quality-control reports.

J. J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 Quality Assurance

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. 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.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
   3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 Project Conditions

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify owner no fewer than two days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without owner's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - Products

2.1 Piping Material

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 Steel Pipe and Fittings

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized, Steel Couplings: ASTM A 865, threaded.

E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME B16.1, Class 125.

H. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
   1. Manufacturers: Subject to compliance with requirements
      a. Anvil International, Inc.
      b. Shurjoint Piping Products.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
      a. Anvil International, Inc.
      b. Corcoran Piping System Co.
      c. National Fittings, Inc.
      d. Shurjoint Piping Products.
      e. Tyco Fire & Building Products LP.
      f. Victaulic Company.
   2. Pressure Rating: 175 psig minimum.
   3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 Piping Joining Materials

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 Listed Fire Protection Valves

A. General Requirements
1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anvil International, Inc.
   b. Victaulic Company.
3. Standard: UL 1091 except with ball instead of disc.
4. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
5. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
6. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Fivalco Inc.
   b. Global Safety Products, Inc.
   c. Milwaukee Valve Company.
3. Standard: UL 1091.
4. Pressure Rating: 175 psig.
5. Body Material: Bronze.
6. End Connections: Threaded.

D. Iron Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.

g. Pratt, Henry Company.
h. Shurjoint Piping Products.
i. Tyco Fire & Building Products LP.
j. Victaulic Company.

3. Standard: UL 1091.
4. Pressure Rating: 175 psig.
5. Body Material: Cast or ductile iron.
6. Style: Lug or wafer.
7. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves.
   f. Crane Co.; Crane Valve Group; Jenkins Valves.
   g. Crane Co.; Crane Valve Group; Stockham Division.
   h. Fire-End & Croker Corporation.
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation.
   l. Groeniger & Company.
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca.
   o. Metraflex, Inc.
   p. Milwaukee Valve Company.
   q. Mueller Co.; Water Products Division.
   r. NIBCO INC.
   s. Potter Roemer.
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products.
   v. Tyco Fire & Building Products LP.
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.
   y. Victaulic Company.
   z. Viking Corporation.
   aa. Watts Water Technologies, Inc. bb. <Insert manufacturer's name>.
3. Standard: UL 312
4. Pressure Rating: 250 psig minimum.

5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.
3. Standard: UL 262.
4. Pressure Rating: 175 psig.
5. Body Material: Bronze.
6. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Shurjoint Piping Products.
   l. Tyco Fire & Building Products LP.
   m. United Brass Works, Inc.
   n. Watts Water Technologies, Inc. o.<Insert manufacturer's name>.
3. Standard: UL 262.
4. Pressure Rating: 250 psig minimum.
5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Shurjoint Piping Products.
   h. Tyco Fire & Building Products LP.
   i. Victaulic Company.
3. Standard: UL 1091.
4. Pressure Rating: 175 psig minimum.
5. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.
6. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
7. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Tyco Fire & Building Products LP. i. <Insert manufacturer's name>.
3. Standard: UL 262.
4. Pressure Rating: 250 psig minimum.

5. Body Material: Cast iron with indicator post flange.
6. Stem: Nonrising.
7. End Connections: Flanged or grooved.

J. Indicator Posts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Tyco Fire & Building Products LP. i. <Insert manufacturer's name>.
3. Standard: UL 789.
4. Type: Horizontal for wall mounting.
5. Body Material: Cast iron with extension rod and locking device.
6. Operation: Hand wheel.

2.5 Trim and Valves

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Affiliated Distributors.
   b. Anvil International, Inc.
   c. Barnett.
   d. Conbraco Industries, Inc.; Apollo Valves.

e. Fire-End & Croker Corporation.
f. Fire Protection Products, Inc.
g. Flowserve.
h. FNW.
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation.
l. Legend Valve.
m. Metso Automation USA Inc.
n. Milwaukee Valve Company.
o. NIBCO INC.
p. Potter Roemer.
q. Red-White Valve Corporation.
r. Southern Manufacturing Group.
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

E. Plug Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
a. Southern Manufacturing Group.

2.6 Specialty Valves

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following
   a. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
3. Standard: UL 260
4. Design: Differential-pressure type.
5. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
6. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      1) AFAC Inc.
      2) Globe Fire Sprinkler Corporation.
      3) Reliable Automatic Sprinkler Co., Inc.
      4) Tyco Fire & Building Products LP.
      5) Venus Fire Protection Ltd.
      6) Victaulic Company.
      7) Viking Corporation.
   c. Standard: UL 260.
   d. Type: Automatic device to maintain minimum air pressure in piping.
   e. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
7. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc,
      3) Viking Corporation.

c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
d. Motor Horsepower: Fractional.
e. Power: 120-V ac, 60 Hz, single phase.

C. Deluge Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
a. AFAC Inc.
b. BERMAD Control Valves.
c. CLA-VAL Automatic Control Valves.
d. Globe Fire Sprinkler Corporation.
e. OCV Control Valves.
f. Reliable Automatic Sprinkler Co., Inc.
g. Tyco Fire & Building Products LP.
h. Venus Fire Protection Ltd.
i. Victaulic Company.
j. Viking Corporation.
3. Standard: UL 260.
4. Design: Hydraulically operated, differential-pressure type.
5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
6. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air- pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
7. Air-Pressure Maintenance Device:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1) AFAC Inc.
2) Globe Fire Sprinkler Corporation.
3) Reliable Automatic Sprinkler Co., Inc.
4) Tyco Fire & Building Products LP.
5) Venus Fire Protection Ltd.
6) Victaulic Company.
7) Viking Corporation.
c. Standard: UL 260.

d. Type: Automatic device to maintain minimum air pressure in piping.
e. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

8. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc,
      3) Viking Corporation.
   c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   d. Motor Horsepower: Fractional.
   e. Power: 120-V ac, 60 Hz, single phase.

D. Automatic (Ball Drip) Drain Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
3. Standard: UL 1726.
4. Pressure Rating: 175 psig minimum.
5. Type: Automatic draining, ball check.
6. Size: NPS 3/4.
7. End Connections: Threaded.

2.7 Fire-Department Connections

A. Exposed-Type, Fire-Department Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.

c. Fire-End & Croker Corporation.
d. Fire Protection Products, Inc.
e. GMR International Equipment Corporation.
f. Guardian Fire Equipment, Inc.
g. Tyco Fire & Building Products LP.
h. Wilson & Cousins Inc.

3. Standard: UL 405.
4. Type: Exposed, projecting, for wall mounting.
5. Pressure Rating: 175 psig minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Round, brass, wall type.
10. Outlet: Back, with pipe threads.
11. Number of Inlets: Three.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
13. Finish: Rough brass or bronze.
14. Outlet Size: NPS 4, NPS 5, NPS 6.

B. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc
   b. Elkhart Brass Mfg. Company, Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.
3. Standard: UL 405.
4. Type: Flush, for wall mounting.
5. Pressure Rating: 175 psig minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Rectangular, brass, wall type.
10. Outlet: With pipe threads.
11. Body Style: Horizontal.
12. Number of Inlets: Three.
13. Outlet Location: Back.

14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
15. Finish: Polished chrome plated.
16. Outlet Size: NPS 4, NPS 5, NPS 6, NPS 8.

C. Yard-Type, Fire-Department Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Wilson & Cousins Inc.
3. Standard: UL 405.
4. Type: Exposed, freestanding.
5. Pressure Rating: 175 psig minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Round, brass, floor type.
10. Outlet: Bottom, with pipe threads.
11. Number of Inlets: Three.
12. Sleeve: Brass.
13. Sleeve Height: 18 inches.
14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
15. Finish, Including Sleeve: Polished chrome plated
16. Outlet Size: NPS 4, NPS 5, NPS 6.

2.8 Sprinkler Specialty Pipe Fittings

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Shurjoint Piping Products.

d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.

c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

G. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.9 Sprinklers

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.

6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psi maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. Residential Applications: UL 1626.
3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:
1. Wax.
2. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 Alarm Devices

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Globe Fire Sprinkler Corporation.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL 753.
   3. Type: Mechanically operated, with Pelton wheel.
   4. Alarm Gong: Cast aluminum with red-enamel factory finish.
   5. Size: 10-inch diameter.
   6. Components: Shaft length, bearings, and sleeve to suit wall construction.
   7. Inlet: NPS 3/4.
   8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire-Lite Alarms; a Honeywell company.
      b. Notifier; a Honeywell company.
      c. Potter Electric Signal Company.
   2. Standard: UL 464.
   3. Type: Vibrating, metal alarm bell.
   4. Size: 8-inch minimum diameter.
   5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Pressure Switches:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AFAC Inc.
      b. Barksdale, Inc.
      c. Detroit Switch, Inc.
      d. Potter Electric Signal Company.
      e. System Sensor; a Honeywell company.
      f. Tyco Fire & Building Products LP.
      g. United Electric Controls Co.
      h. Viking Corporation.
   2. Standard: UL 346.
   3. Type: Electrically supervised water-flow switch with retard feature.
   4. Components: Single-pole, double-throw switch with normally closed contacts.
   5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Fire-Lite Alarms; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company. e. <Insert manufacturer's name>.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

F. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company. c. <Insert manufacturer's name>.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position

2.11 Manual Control Stations

A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 Control Panels

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.13 Pressure Gages

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following;
1. AMETEK, Inc.; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.14 Escutcheons

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.

C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw.

E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.

F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw.

G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.15 Sleeves

A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

H. Underdeck Clamp: Clamping ring with set-screws.

2.16 Sleeve Seals

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.17 Grout

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - Execution

3.1 Preparation

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 Service Entrance Piping

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 21 1100, FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 Water Supply Connections

A. Connect sprinkler piping to building's interior water-distribution piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 Piping Installation

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.

K. Connect compressed-air supply to dry-pipe sprinkler piping.

L. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

M. Install alarm devices in piping systems.

N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

P. Drain dry-pipe sprinkler piping.

Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.

3.5 Joint Construction

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

K. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 Valve and Specialties Installation

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
   a. Install air compressor and compressed-air supply piping.
   b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
   c. Install compressed-air supply piping from building's compressed-air piping system.

3.7 Sprinkler Installation

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet- type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.8 Fire Department Connection Installation

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 03 3000, CAST-IN-PLACE CONCRETE.
   1. Install three protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Section 05 5000, METAL FABRICATIONS.

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.9 Escutcheon Installation

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
   5. Bare Piping in Equipment Rooms: One piece, cast brass.
   6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:
   1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
   2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
   3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
   4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
   5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
   6. Bare Piping in Equipment Rooms: Split casting, cast brass.
   7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.10 Sleeve Installation

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Section 07 9200, JOINT SEALANTS.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Section "07 9200, JOINT SEALANTS.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe unless otherwise indicated.

K. Install sleeve materials according to the following applications:
   1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
   2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
      a. Extend sleeves 2 inches above finished floor level.
      b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Section 07 6200, SHEET METAL FLASHING AND TRIM.
   3. Sleeves for Piping Passing through Gypsum-Board Partitions:
      a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
      b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
      c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
   4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
   5. Sleeves for Piping Passing through Exterior Concrete Walls:
      a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
      b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
      c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe when sleeve seals are used.
   6. Sleeves for Piping Passing through Interior Concrete Walls:
      a. Galvanized-steel pipe sleeves for pipes smaller than NPS 6.

b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Section 07 8413, PENETRATION for firestop materials and installations.

3.11 Sleeve Seal Installation

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 Identification

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553, IDENTIFICATION FOR ELECTRICAL.

3.13 Field Quality Control

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 Cleaning

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.15 Demonstration

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.16 Piping Schedule

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6, shall be one of the following:

G. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3.17 Sprinkler Schedule

A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Dry pendent, recessed, flush, and concealed sprinklers as indicated.

3. Wall Mounting: Dry sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, dry pendent sprinklers; and dry sidewall sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 16

SECTION 21 22 00 – CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

PART 1 - General

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section:

1.2 Summary

A. Section Includes:
1. Piping and piping specialties.
2. Extinguishing-agent containers.
3. Extinguishing agent.
4. Detection and alarm devices.
5. Control and alarm panels.
6. Accessories.
7. Connection devices for and wiring between system components.
8. Connection devices for power and integration into building's fire-alarm system.

1.3 Definitions

A. ATS: Acceptance Testing Specifications.

B. EPO: Emergency Power Off.

1.4 Action Submittals

A. Product Data: For each type of product indicated.

B. LEED Submittals:
1. Product Data for Credit EA 4: Documentation indicating that clean agents comply.

C. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.
1. Include plans, elevations, sections, details, and attachments to other work.
2. Include design calculations.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.
   1. Indicate compliance with performance requirements and design criteria, including analysis data.
   2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
   3. Indicate the Following on Reflected Ceiling Plans:
      a. Ceiling penetrations and ceiling-mounted items.
      b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
      c. Method of attaching hangers to building structure.
      d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
   4. Indicate the Following on Occupied Work Area Plans:
      a. Controls and alarms.
      b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
      c. Equipment and furnishings.
   5. Indicate the Following on Access Floor Space Plans:
      a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
      b. Method of supporting piping.

E. Indicate the Following on Ceiling Plans:
      a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
      b. Method of supporting piping.
      c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

1.5 Informational Submittals

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Domestic water piping.
   2. Items Penetrating Finished Ceiling Include the Following:
      a. Lighting fixtures.
      b. Air outlets and inlets.

B. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.

C. Seismic Qualification Certificates: For extinguishing-agent containers and control panels from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1.6 Closeout Submittals

A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.

1.7 Maintenance Material Submittals

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
   1. Detection Devices: Not less than 20 percent of amount of each type installed.
   2. Container Valves: Not less than 10 percent of amount of each size and type installed.
   3. Nozzles: Not less than 20 percent of amount of each type installed.
   4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.8 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. FM Global Compliance: Provide components that are FM Approved and that are listed in FM Global's "Approval Guide."

C. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

PART 2 - PRODUCTS

2.1 Clean Agent Systems

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Ansul Incorporated.
   2. Chemetron Fire Systems; a UTC Fire & Security company.
   3. Fike Corporation.
   4. Pem All Fire Extinguisher Corporation; a division of Pem Systems Inc.
   5. Pyro-Chem.
   6. Siemens Building Technologies, Inc.; Fire Safety Division.

C. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling, and below the raised floor. System includes separate zones above and below the ceiling and beneath the raised floor. If smoke is detected below the raised floor, extinguishing agent shall be discharged in the underfloor zone only. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling and below the floor. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.

D. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.

E. Performance Requirements: Discharge HFC 227ea within 10 seconds and maintain 7.1 percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.
   1. HFC 227ea concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 5.8 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
   2. System Capabilities: Minimum 620-psig calculated working pressure and 360-psig initial charging pressure.

F. Performance Requirements: Discharge FK-5-1-12 within 10 seconds and maintain 6.6 percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.
   1. FK-5-1-12 concentration in hazard areas greater than 10.0 percent immediately after discharge or less than 6.5 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
   2. System Capabilities: Minimum 620-psig calculated working pressure and 360-psig initial charging pressure.

G. Performance Requirements: Discharge IG-541 within 60 seconds and maintain 38 percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.
   1. IG-541 concentration in hazard areas greater than 40 percent immediately after discharge or less than 32 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.

2. System Capabilities: Minimum 2175-psig calculated working pressure upstream from orifice union, minimum 1000-psig calculated working pressure downstream from orifice union, and 2175-psig initial charging pressure.

H. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.

I. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.

J. System Operating Sequence:
1. Actuating First Detector: Visual indication on annunciator panel. Energize audible and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire-alarm system.
2. Actuating Second Detector: Visual indication on annunciator panel. Energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing- agent discharge for 30 seconds, and discharge extinguishing agent. On agent discharge, release pre-action valve to allow water to fill sprinkler system.
3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.

K. System Operating Sequence: System shall be cross-zoned, air-sampling detectors and photoelectric detectors reporting to a fully programmable microprocessor-based control panel programmed to operate as follows:
1. If one photoelectric detector and air-sampling detector reaches the third detection level (Fire 1), agent discharge will be initiated as described for the third detection level (Fire 1) below.
2. Air-Sampling System:
   a. First Detection Level (Alert): Mild audible and visual indication on annunciator panel. Strobe lights flash slowly in the protected area.
   b. Second Detection Level (Action): Strong audible and visual indication on annunciator panel. Strobe lights flash rapidly in the protected area.
   c. Third Detection Level (Fire 1): Strong audible and visual indication on annunciator panel. Energize horn(s), bell(s), and strobe light(s) in the protected area and outside entry doors. Shut down air-conditioning and ventilating systems serving the protected area, and close doors in the protected area. Send signal to fire-alarm system, initiate 30-second time delay for extinguishing-agent discharge, and discharge extinguishing agent. At agent discharge, terminate power to equipment in the protected area, and release pre-action valve to allow water flow to sprinkler system.
   d. Fourth Detection Level (Fire 2): Same as Fire 1.

L. Manual stations shall immediately discharge extinguishing agent when activated.

M. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.

N. EPO: Will terminate power to protected equipment immediately on actuation.

O. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.

P. Power Transfer Switch: Transfer from normal to stand-by power source.

Q. Seismic Performance: Fire-suppression piping and containers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 Piping Materials

A. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

2.3 Piping and Fitting

A. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, Grade A and Grade B; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
1. Threaded Fittings:
   a. Malleable-Iron Fittings: ASME B16.3, Class 300.
   b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.
   c. Fittings Working Pressure: 620 psig minimum.
   d. Flanged Joints: Class 300 minimum.
2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

B. 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 maximum thickness unless thickness or specific material is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.4 Valves

A. General Valve Requirements:
   1. UL listed or FM Approved for use in fire-protection systems.
   2. Compatible with type of clean agent used.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.5 Extinguishing Agent Containers

A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
   1. Finish: Red, enamel or epoxy paint.
   2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
   3. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.6 Fire–Extinguishing Clean Agent

A. HFC 227ea Clean Agent: Heptafluoropropane.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. DuPont.
      b. Great Lakes Chemical Corporation; a Chemtura company.

2.7 Discharge Nozzles

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

2.8 Manifold and Orifice Unions

A. Description: NRTL-listed device with minimum 2175-psig pressure rating, to control flow and reduce pressure of IG-541 gas in piping.
   1. NPS 2 and Smaller: Piping assembly with orifice, sized for system design requirements.
   2. NPS 2-1/2 and Larger: Piping assembly with nipple, sized for system design requirements.

2.9 Control Panels

A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
   1. Mounting: Recessed flush with surface.

D. Supervised Circuits: Separate circuits for each independent hazard area.
   1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
   2. Manual pull-station circuit.
   3. Alarm circuit.
   4. Release circuit.
   5. Abort circuit.
   6. EPO circuit.

E. Control-Panel Features:
   1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
   2. Automatic switchover to standby power at loss of primary power.
   3. Storage container, low-pressure indicator.
   4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.

F. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.

G. Standby Power: Batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

2.10 Detection Devices

A. General Requirements for Detection Devices:
   1. Comply with NFPA 2001, NFPA 72, and UL 268.
   2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.
   1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
   2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
   3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg at all sampling ports.
   4. Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.

E. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

2.11 Manual Stations

A. General Description: Surface FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

D. EPO Switch: "EPO" caption, with yellow finish.

2.12 Switches

A. Description: FM Approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
   1. Low-Agent Pressure Switches: Pneumatic operation.
   2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
   3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.13 Alarm Devices

A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Division 28 Section "Digital, Addressable Fire-Alarm System" or Division 28 Section "Zoned (DC Loop) Fire-Alarm System" for alarm and monitoring devices.

B. Bells: Minimum 6-inch diameter.

C. Horns: 90 to 94 dBA.

D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

2.14 Electrical Power and Wiring

A. Electrical power, wiring, and devices are specified in Division 26.

PART 3 - Execution

3.1 Examination

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HFC 227ea agent Piping Applications

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. NPS 2 and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.

C. NPS 2-1/2 and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

3.3 Clean-Agent Piping Installation

A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.

B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.

C. Install extinguishing-agent containers anchored to substrate.

D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."
   1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.
   2. Support piping using supports and methods according to NFPA 13.
   3. Install seismic restraints for extinguishing-agent containers and piping systems if required.
   4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.4 Connections

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Division 28 Section "Digital, Addressable Fire-Alarm System" or Division 28 Section "Zoned (DC Loop) Fire-Alarm System."

3.5 Identification

A. Identify system components and equipment. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.

C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.

D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.6 Field Quality Control

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 Cleaning

A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.8 System Filling

A. Preparation:
1. Verify that piping system installation is completed and cleaned.
2. Check for complete enclosure integrity.
3. Check operation of ventilation and exhaust systems.

B. Filling Procedures:
1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to the indicated charging pressure.
2. Install filled extinguishing-agent containers.
3. Energize circuits.
4. Adjust operating controls.

3.9 Demonstration

A. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems

END OF SECTION 21 22 00

Division 22 – Plumbing

22 00 01	Plumbing Design General Guidelines
22 00 02	Design Review Requirements
22 11 23	Domestic-Water Packaged Booster Pumps
22 14 29	Administrative Requirements
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22 33 36	Commercial Storage Electric Domestic Water Heaters
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22 66 53	Laboratory Chemical-Waste and Vent Piping
22 66 83	Chemical-Waste Dilution Tanks

Division 22 – Plumbing

SECTION 22 00 01 – PLUMBING DESIGN GENERAL GUIDELINES

PART 1 - Introduction

1.1 Purpose and Scope

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of plumbing systems which satisfy the functional and operational requirements of Alamo Colleges. Deviations from these guidelines must be submitted to Owner for approval.

PART 2 - General Design Requirements

2.1 Basic Design Guidance

A. Plumbing Trap primers should be a non-electro mechanical trap primer unless a fixture trap primer isn't possible.

B. Use Cast Iron Pipe as the primary material for the Building Waste and Vent System. PVC piping shall only be used as an alternate material.

C. When using PVC (in lieu of Cast Iron for building drainage systems) under slab or for slab on grade foundations, do not use test tees.

D. Mixing cast iron pipe and PVC pipe, under slab, is strictly prohibited on building drainage (sanitary) system.

E. All indirect waste shall be piped to a floor drain or floor sink.

F. Air admittance valves are strictly prohibited.

G. Use of Horizontal Double Combination eighth bend (any size) for in building waste system is strictly prohibited.

H. Seal all openings around piping.

I. Provide metal sleeves for piping passing through walls and provide fire proofing materials to meet the required rating.

J. Provide all take-offs from main water supply lines with cutoff valves and provide sufficient clearance for access to valves.

K. Provide isolation valve for each pipe riser or group of fixtures to allow system shutdown in sections.

L. Always provide siphon breakers in pipe lines to hose bib-type faucets.

M. Use plugged tees rather than elbows to provide clean out points in plumbing piping.

N. Provide keyed hose bibs within 20' of main entrance and rear exit no more than 100' apart around outside perimeter of a new building. Outdoor hose bib shall be non-freeze proof type.

O. All valves concealed within enclosing construction shall be made accessible via appropriate metal access doors. Their location and size shall be provided to the architect/engineer with a record document to be signed off on.

P. Provide floor drains, minimum 3", in all restrooms and custodial closets. Large restrooms may require 2 or more floor drains

Q. All traps that are remote from a commonly used fixture shall have an electro mechanical trap primer. The trap primer must be readily accessible.

R. Utilize 12" X 12" floor sinks in Mechanical Rooms.

S. Size pipe chases to be large enough to accommodate the piping to be housed in chases and to be accessible. Locate piping in chases to avoid the obstruction of entrances or openings to pipe chases.

T. The design engineer shall work with the lead Architect to provide a minimum of 3'-6" crawl space beneath new buildings. The crawl space shall be easily accessible with lighting.

U. Plan for adequate working space for easy access to all working parts of all plumbing equipment and devices.

V. Do not permanently seal in masonry wall those items of plumbing requiring periodic maintenance or repair.

W. Pipes should not be run above electric panels, transformers, etc.

X. Include a sub-water meter in each new building. The water meter shall be able to be connected to the campus EMCS.

Y. Water meter shall be positive-displacement turbo-compound type with readout featuring both odometer dial and electronic pulse output. An in-line strainer shall be provided ahead of any water meter.

Z. Locate the water meter inside a building and install horizontally at 5 feet above finished floor.

AA. Include a 1-200 psi pressure gauge, 4-inch or larger, on the domestic water header.

BB. Do NOT use 3-1/2 and 5-inch pipe.

CC. Required minimum size for sanitary sewer line leaving buildings is 8" PVC.

DD. For new building with provision for future growth or changes, provide additional capacities for the various plumbing system so as to allow expansion without total replacement of the existing system. These systems include, but not limited to the following:

a.	Hot Water Heaters	25%
b.	Hot Water Mains	25%
c.	Cold Water Mains	30%
d.	Sanitary Sewer Mains	30%
e.	Storm Drainage Mains	20%

PART 3 - Modification of Existing Facilities

3.1 Site Investigation - Designers shall conduct thorough site investigations of existing facilities to be upgraded or modified. Designers are required to inspect all equipment rooms and above ceiling conditions to establish existing conditions.

3.2 Modifications to existing systems shall be shown and described in design documents. Phasing drawings shall include, if required, temporary connections and measures necessary to sustain service. If service is to be altered or interrupted, duration of interruption should be discussed with ACCD during design.

END OF SECTION 22 00 01

SECTION 22 00 02 - DESIGN REVIEW REQUIREMENTS

PART 1 - Design Analysis

1.1 Provide a design analysis at every submittal

1.2 Design analysis shall contain the following information as applicable to submittal:

- a. Basis of design
  - 1) Narrative with design parameters
  - 2) Assumptions
- b. Building domestic cold and hot water demand calculations
- c. Calculations supporting equipment selection
- d. Equipment cut-sheets
- e. Criteria and codes
- f. LEED Check list.
- g. Energy compliance

PART 2 - Preliminary Concept Submittal

2.1 New Campus Alternatives

A. For New Campus or buildings which are stand-alone the designer shall provide an initial estimate domestic water, sanitary waste, and Gas demand to the project team civil engineer.

2.2 Existing Campus

A. New Building - Designer shall meet with Alamo Colleges project manager and verify capacity, connection points and available pipe sizes. Designer shall provide projected loads on campus infrastructure and verify adequate capacity for new project.

B. Renovation or addition to Existing Building - Designer shall verify current demand and determine if the future needs of the project can be supported by the existing infrastructure.

C. Provide design analysis.

PART 3 - Schematic Design (35%)

3.1 For the system approved and selected, provide the following where applicable:

A. Drawings - New Work
   1. Plumbing Systems mains and major laterals with estimated pipe size.
   2. Equipment room showing major equipment. Indicate access to equipment and maintenance clearance requirements. Equipment rooms shall be drawn at 1/4" = 1'-0"

B. Demolition Drawings

C. Major Equipment Schedules

D. Design Analysis

E. Outline specifications

PART 4 - Design Development (65%)

4.1 For the system approved and selected, provide the following where applicable:

A. Drawings - New Work
   1. Develop plans to show all major and lateral piping sized with point so service coordinated with the civil engineer.
   2. Locate all major equipment in mechanical room at 1/4" = 1'-0". Indicate access to plumbing equipment and maintenance clearance requirements.
   3. Provide plumbing fixture and equipment schedule

B. Demolition Drawings shall indicate major component to be removed.

C. Details

D. Phasing Drawings, if required.

E. Design Analysis

F. Edited Specifications

PART 5 - Construction Documents (100%)

5.1 For the system approved and selected, provide the following where applicable:

A. Drawings - New Work
   1. Fully developed plans with all piping sized and coordinated with the mechanical ductwork in the ceiling plenum and electrical equipment locations.
   2. Complete layout of plumbing equipment with all connections and valves sized shown in the Mechanical room fully coordinated with other mechanical equipment. The sections and elevations shall be provided for clarity at 1/4" = 1'-0". Indicate access to equipment and maintenance clearance requirements.

B. Roof Plan shall indicate the location of plumbing vent with respect to outside air intakes associated with the mechanical systems.

C. Demolition Drawings

D. Complete plumbing fixture and equipment Schedules

E. Details

F. Fully developed riser diagrams for waste, vent, domestic (cold and hot), acid waste/vent, vacuum system, laboratory compressed air and natural gas piping.

G. Phasing Drawings

H. Design Analysis shall include all calculations.

I. Edited Specifications

PART 6 - Drawing Requirements

6.1 Drawings must be accurate and to scale. Drawings shall be produced in the latest version of Revit. Revit and bound CAD files shall be provided with final drawings. (COORDINATE WITH ARCH)

6.2 One bookmarked PDF file containing all plumbing drawings with hyperlink table of contents shall be provided at every submittal.

END OF SECTION 22 00 02

SECTION 22 11 23 – DOMESTIC-WATER PACKAGED BOOSTER PUMPS

PART 1 - General

1.1 Reference Standards

A. Motor- NEMA standards

B. Controls-National Electrical Code and the complete assembly shall have the UL listing mark for industrial control panels.

C. Pressure Tanks-ASME certified and stamped

1.2 Warranty

A. Provide a one-year warranty from the construction completion date of the project.

PART 2 - Products

2.1 Manufacturers

A. ITT Domestic.

B. SyncroFlo.

C. TIGERFLOW Systems

2.2 Equipment & Materials

A. The station shall provide varying water flow rate at a constant pressure or ASHRAE 90.1 compliant pressure profile through the use of a PID PLC controller and variable speed drives

B. Vertical Multistage pumps.

C. Dedicated variable frequency drives for each pump with individual disconnects.

D. Common suction and discharge manifolds with grooved at both ends to allow change of suction and discharge connection.

E. geometry in the field

F. A common base or frame for all components.

G. Stainless Steel headers, valves and none-slam check valves.

H. Hydro- Pneumatic Tank, when provided, shall have Section VIII, ASME Code, National Board stamped, hydro-pneumatic tank.

I. A solid-state programmable logic controller (PLC) with non-volatile memory. Controller shall allow web-enabled access and control of the local station via a browser on a desktop/laptop or web enabled mobile devices. The control shall provide Building Automation System communication through Modbus or BACnet protocol.

2.3 Finishes

A. The entire booster system shall be factory prefabricated on a common structural steel stand with all interconnecting piping and wiring completed and operationally tested prior to shipment. Include isolation valves on the suction and discharge of each pump. Type L copper suction and discharge pipe manifolds, as well as copper tubing with shutoff cocks for gauges and pressure switches, will be furnished assembled. The suction and discharge headers, the drain tube, and the power connection at the control panel shall be the only field connection.

B. Factory shall certify in writing that the water pressure booster system and its component parts have undergone a complete electric and hydraulic test prior to shipment.

C. Testing shall include a system operating flow test from zero to 100% design flow rate under the specified suction and net system pressure conditions. The certification shall include copies of the test data as recorded by X-Y plotter.

D. Each pump motor shall operate within the nameplate horsepower at any point on the pump capacity head curve.

E. Pre-charged hydro-pneumatic tank shall include an ASME relief valve, an air fill valve, an air pressure gauge, a drain valve, and a replaceable flexible membrane to separate air and water. The tank shall be bottom fed and capable of 100% draw down.

PART 3 - Execution

3.1 Installation

A. At least Four (4) hours of start-up service and field training shall be provided.

B. If required, remote mounted instrumentation, control wiring and mapping of BAS communication points shall be the specified in the construction documents.

3.2 Testing

A. A factory trained representative shall be made available on the job-site to check installation and start-up and instruct operating personnel.

B. The contractor shall notify the Engineer and Owner in writing three (3) weeks prior to testing and startup of the pumps.

END OF SECTION 22 11 23

SECTION 22 14 29 – SUBMERSIBLE SUMP PUMPS

PART 1 - General

A. ASTM A48-C30, ANSI

1.2 Warranty

A. 3 years from substantial completion date.

PART 2 - Products

2.1 Manufacturers

A. Deming

B. Pacific

C. Peabody Barnes

D. Weil

2.2 Equipment & Materials

A. Pump shall alternate from leg to lag with every call of the pump. I should also, be able to be connected to the Bas system (alarm).

B. Pumps shall be capable of handling raw, unscreened sewage. Each pump shall be equipped with a hermetically sealed Class "F" insulated motor installed in a heavy ribbed cast iron shell. The motor shell, pump volute and impeller shall be made of close-grained cast iron (ASTM A48-C30).

C. Pump shaft shall be Type 316 stainless steel and all fastening hardware shall be stainless steel.

D. The pump impeller shall be two-vane, non-clog type accurately machined to the proper diameter and dynamically balanced prior to installation in pump.

E. The pump unit shall be furnished with a moisture sensing probe and relay panel with light to indicate entrance of water to the motor.

F. Pump and motor unit shall be coated with red chromate primer and a finish coat of water resistant metallic enamel.

G. The control panel furnished shall be UL listed NEMA 3R, Operation of System:

H. On liquid level rise to the pump basin, the lowest level mercury switch will energize, the next level switch will energize, starting the duty pump. Duty pump will operate until the lowest level switch is de-energized.

I. On next liquid level rise, the alternate pump will be started and again will operate until the lowest level switch is de-energized.

J. Should liquid level continue to rise when one pump is operating, the standby (or third switch) will be energized, starting the idle or standby pump. Both pumps will continue to operate until the lowest level switch is de-energized.

K. Should liquid level continue to rise after both pumps are operating, the alarm (or fourth) switch will be energized operating the visual and audible alarms.

PART 3 - Execution

3.1 Installation

A. Must have enough vertical clearance remove the unit as a complete unit. Install in strict accordance with manufacturer's instructions.

B. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections before pump installation.

C. Drainage Pump Units: Install and make direct connections to storm drainage piping.

3.2 Testing

A. Test piping system in accordance with manufacturer's recommendations and local code requirements.

B. Operate the pumping system for a period of 8 hours and check for any leaks.

END OF SECTION 22 14 29

SECTION 22 33 13 – INSTANTANEOUS ELECTRIC DOMESTIC WATER HEATERS

PART 1 - General

1.1 Reference Standards

A. Water heaters shall be inspected and bear the ASME Section IV – Heating Boilers seal for 150 design pressure.

B. Water heating equipment shall meet the minimum performance requirements set forth in Table 11.1 of the State of Texas Energy Conservation Standards for New State Buildings.

C. Hook up water heater to soft water when possible.

1.2 Warranty

A. Provide three (3) year warranty on water heaters from the substantial construction date of completion.

PART 2 - Products

2.1 Manufacturers

A. Eemax

B. Chronomite

C. Rheem

2.2 Equipment & Materials

A. Water heater shall be UL listed.

PART 3 - Execution

3.1 Installation

A. Connect to separately fused disconnect switch in accordance with Division 26.

B. Install in strict accordance with manufacturer's instructions.

END OF SECTION 22 33 13

SECTION 22 33 36 – COMMERCIAL STORAGE ELECTRIC DOMESTIC WATER HEATERS

PART 1 - General

1.1 Reference Standards

A. Water heaters shall be inspected and bear the ASME Section IV – Heating Boilers seal for 150 design pressure.

B. Water heating equipment shall meet the minimum performance requirements set forth in Table 11.1 of the State of Texas Energy Conservation Standards for New State Buildings.

C. Hook up water heater to soft water when possible.

1.2 Warranty

A. Provide three (3) year warranty on water heaters from the construction date of completion.

PART 2 - Products

2.1 Manufacturers

A. A.O. Smith.

B. Bradford White

C. Lochinvar

D. PVI

2.2 Equipment:

A. Water heater shall be UL listed, meets ASHRAE 90.1-2010, and have Energy Star qualitied.

B. Meets ASHRAE 90.1-2010

C. Heater shall have heater element and a baked enamel finish.

PART 3 - Execution

3.1 Installation

A. Connect to separately fused disconnect switch in accordance with Division 26.

B. Install in strict accordance with manufacturer's instructions.

C. Allow water heater to obtain operating temperature and cycle off.

END OF SECTION 22 33 36

SECTION 22 34 36 – COMMERCIAL, HIGH EFFICIENCY, GAS DOMESTIC WATER HEATERS

PART 1 - General

1.1 Reference Standards

A. Gas-fired water heating equipment shall be design certified and tested by American Gas Association Laboratories.

B. Water heaters shall be inspected and bear the ASME Section IV – Heating Boilers seal for 150 PSI working pressure and shall have the National Board (ASME) Registration.

C. The venting requirements shall be based on National fuel gas code other pluming local codes.

D. The Low NOx 96% Efficiency water heater shall comply with ANSI Z21.10.3 standards and NFPA 54.

E. The water heater shall comply with paragraph 7.2.4.4 of ASHRAE 90.1, 2013-standards.

F. Hook up water heater to soft water when possible.

1.2 Warranty

A. Provide Five (5) year warranty on water heaters from the substantial completion date of construction.

PART 2 - Products

2.1 Manufacturers

A. A.O. Smith.

B. Bradford White.

C. Lochinvar.

D. PVI.

E. State.

2.2 Equipment & Materials

A. Electronic operating system with integrated ignition and operating controls

B. Programmable electronic operator with digital temperature readouts, adjustable from 80°F to 180°F

C. Plain text heater status and diagnostics with event history

D. Alarm with remote contacts

E. Visual modulation rate

F. Manual-reset temperature limiting device

G. Modbus RTU connectable

H. Electronic low-water cutoff with manual reset and test switch.

I. Specify condensate neutralization system for each system.

PART 3 - Execution

3.1 Installation

A. The area of installation shall comply with national fire code and the area must provide enough ventilation.

B. Specify Factory authorized startup.

END OF SECTION 22 34 3

SECTION 22 42 13 WATER CLOSETS AND URINALS

PART 1 - General

1.1 Reference Standards

A. All plumbing fixtures and trim shall be manufactured in the U.S.A.

B. All water faucets and valve bodies shall be cast bronze.

C. Plumbing fixtures shall be approved for use by the Water Utilities Division of the Texas Natural Resource Conservation commission (TNRCC)

D. Texas Accessibility Standards (TAS) and NSF61

E. Facilities Superintendent must approve all fixtures and valves. Must try to match what is common for that campus.

F. Fixture cutoff valves shouldn't be loose key, unless a silcock is required in the restroom.

G. Drinking fountain cutoffs must be ready accessible.

H. Backflow valves requirements must be approved by Certified Cross Connection Control Specialist.

1.2 Warranty

A. Provide one warranty from the construction date of completion.

PART 2 - Products

2.1 Manufacturers

A. Water Closets and Urinals:
   1. American Standard.
   2. Briggs.
   3. Crane.
   4. Eljer.
   5. Kohler.
   6. Toto.

B. Flush Valves:
   1. Delany.
   2. Sloan Royal, Regal, Solis, Ecos.
   3. Zurn.

C. Toilet Seats:

1. Bemis.
2. Beneke.
3. Church.
4. Centoco.
5. Olsonite.

D. Carriers:
1. Jay. R. Smith.
2. Josam.
3. Wade.

E. Must be approved by Facilities Superintendent.

2.2 Equipment & Materials

A. Plumbing fixtures mounting heights shall comply with ADA guidelines and TAS requirements
B. Wall hung water closets (vitreous china)
C. Floor mounted water closets (vitreous china)
D. Wall hung urinal (vitreous china)

2.3 Finishes

A. As required per construction documents.

PART 3 - Execution

3.1 Installation

A. Confirm location, size of fixtures and openings before rough-in and installation

B. Secure floor outlet fixtures to floor.

C. Rough-in fixture piping connections in accordance with local plumbing codes.

3.2 Protection / Cleaning

A. Protective coating liner shall not be removed until the plumbing fixture has been completely installed.

END OF SECTION 22 42 13

SECTION 22 42 16 LAVATORIES AND SINKS

PART 1 - General

1.3 Reference Standards

A. All plumbing fixtures and trim shall be manufactured in the U.S.A.

B. All water faucets and valve bodies shall be cast bronze.

C. Plumbing fixtures shall be approved for use by the Water Utilities Division of the Texas Natural Resource Conservation commission (TNRCC)

D. Texas Accessibility Standards (TAS) and NSF61

E. Facilities Superintendent must approve all fixtures and valves. Must try to match what is common for that campus.

F. Fixture cutoff valves shouldn't be loose key, unless a silcock is required in the restroom.

G. Drinking fountain cutoffs must be ready accessible.

H. Backflow valves requirements must be approved by Certified Cross Connection Control Specialist.

1.4 Warranty

A. Provide one warranty from the construction date of completion.

PART 2 - Products

2.1 Manufacturers

A. Lavatories:
   1. American Standard.
   2. Briggs.
   3. Crane.
   4. Eljer.
   5. Kohler.
   6. Toto.

B. Stainless Steel Sinks:
   1. Elkay.
   2. Just.
   3. Aqua Glass

4. Fiat/Crane.
5. Lasco.
6. Sloan.
7. Zurn.
8. Carriers:
9. Jay. R. Smith.
10. Josam.
11. Wade.
12. Zurn.

C. Faucets:
1. American Standard.
2. Bradley.
3. Chicago.
4. Delta.
5. Eljer.
6. Elkay.
7. Just.
8. Kohler.
9. Royal Brass.
10. Symmons.
11. T&S Brass.

D. Faucet Supplies, Stops and Drain Fittings:
1. American Standard.
2. Chicago.
3. Eljer.
4. Elkay
5. Just.
6. Kohler.
7. McGuire.
8. Royal Brass.
9. T&S Brass.

E. Thermostatic Mixing Valves:
1. Armstrong.
2. Leonard.
3. Powers.
4. Symmons..
5. Insulation:
6. Pro Wrap.
7. Truebro.

F. Must be approved by Facilities Superintendent.

2.2 Equipment & Materials

A. Plumbing fixtures mounting heights shall comply with ADA guidelines and TAS requirements
B. Wall hung mounted lavatory (vitreous china)
C. Counter mounted lavatory (vitreous china)

D. Under-counter mounted lavatory (vitreous china)
E. Double Compartment stainless steel sink
F. Stainless steel bar sink

2.3 Finishes

A. As required per construction documents.

PART 3 - Execution

3.3 Installation

A. Confirm location, size of fixtures and openings before rough-in and installation
B. Rough-in fixture piping connections in accordance with local plumbing codes.

3.4 Protection / Cleaning

A. Protective coating liner shall not be removed until the plumbing fixture has been completely installed.

END OF SECTION 22 42 16

SECTION 22 42 23 SHOWER RECEPTORS AND BASINS

PART 1 - General

1.5 Reference Standards

A. All plumbing fixtures and trim shall be manufactured in the U.S.A.

B. All water faucets and valve bodies shall be cast bronze.

C. Plumbing fixtures shall be approved for use by the Water Utilities Division of the Texas Natural Resource Conservation commission (TNRCC)

D. Texas Accessibility Standards (TAS) and NSF61

E. Facilities Superintendent must approve all fixtures and valves. Must try to match what is common for that campus.

F. Fixture cutoff valves shouldn't be loose key, unless a silcock is required in the restroom.

G. Backflow valves requirements must be approved by Certified Cross Connection Control Specialist.

1.6 Warranty

A. Provide one warranty from the construction date of completion.

PART 2 - Products

2.4 Manufacturers

A. Showers Valve Assemblies:
1. Acorn Eng. Co.
2. Bradley.
3. Chicago.
4. Leonard.
5. Powers.
6. Speakman.
7. Symmons.
8. T&S Brass.

B. Shower Modules:
1. Aquarius.
2. Aqua Glass
3. Fiat/Crane.
4. Lasco.

C. Floor Drains:
   1. MIFAB.
   2. Jay. R. Smith.
   3. Josam.
   4. Wade.
   5. Zurn.

D. Thermostatic Mixing Valves:
   1. Armstrong.
   2. Leonard.
   3. Powers.
   4. Symmons.

2.5 Equipment & Materials

A. Plumbing fixtures mounting heights shall comply with ADA guidelines and TAS requirements
B. Furnish and install a floor mounted fiberglass plasticpolymer shower module with basin.

2.1 Finishes

A. As required per construction documents.

PART 3 - Execution

3.5 Installation

A. Confirm location, size of fixtures and openings before rough-in and installation
B. Secure shower module to the floor.
C. Rough-in fixture piping connections in accordance with local plumbing codes.

3.6 Protection / Cleaning

A. Protective coating liner shall not be removed until the plumbing fixture has been completely installed.

END OF SECTION 22 42 23

SECTION 22 42 43 - FLUSHOMETERS

PART 1 - General

1.7 Reference Standards

A. All plumbing fixtures and trim shall be manufactured in the U.S.A.

B. All water faucets and valve bodies shall be cast bronze.

C. Plumbing fixtures shall be approved for use by the Water Utilities Division of the Texas Natural Resource Conservation commission (TNRCC)

D. Texas Accessibility Standards (TAS) and NSF61

E. All flush valves shall be Dual-flush capable (this requirement shall be coordinate with each campus).

F. Facilities Superintendent must approve all fixtures and valves. Must try to match what is common for that campus.

G. Fixture cutoff valves shouldn't be loose key, unless a silcock is required in the restroom.

H. Drinking fountain cutoffs must be ready accessible.

I. Backflow valves requirements must be approved by Certified Cross Connection Control Specialist.

1.8 Warranty

A. Provide one warranty from the construction date of completion.

PART 2 - Products

2.2 Manufacturers

A. Flush Valves:
1. Delany
2. Sloan Royal, Regal, Solis, Ecos
3. Zurn

B. Must be approved by Facilities Superintendent.

2.3 Equipment & Materials

A. Plumbing fixtures mounting heights shall comply with ADA guidelines and TAS requirements

1. The flushometer valves shall be manual operated or sensor driven.
2. The flushometer valves shall be an exposed type not concealed.

2.4 Finishes

A. As required per construction documents.

PART 3 - Execution

3.7 Installation

A. Confirm location, size of fixtures and openings before rough-in and installation.

B. Rough-in fixture piping connections in accordance with local plumbing codes.

3.8 Protection / Cleaning

A. Protective coating liner shall not be removed until the plumbing fixture has been completely installed.

END OF SECTION 22 42 43

SECTION 22 61 19 – LABORATORY COMPRESSED AIR EQUIPMENT

PART 1 - General

1.1 Reference Standards

A. B40.1-85 - Gauges-Pressure Indicating Dial Type-Elastic Element.

B. NFPA 99 - Latest edition

C. ASME Section VIII, 125 PSIG working pressure stamped and certified.

D. American Society of Mechanical Engineers (ASME):

E. ASTM B88, ANSI B16.22.

1.2 Warranty

A. Provide a 5-year warranty from the date of substantial completion of construction.

PART 2 - Products

2.1 Manufacturer

A. Beacon

B. Or Approved Equal.

2.2 Equipment & Materials

A. Oil-Less Scroll Laboratory air package features a common base with single point connections for electrical, discharge air, and condensate drains.

B. The compressors shall have continuous duty rated scroll type, single stage and air-cooled.

C. Receiver Tank: Welded steel, galvanized, in compliance with ASME Section VIII, 150 PSIG working pressure stamped and certified. The tank shall be piped with 3-valve bypass assembly with flange-fitted valves.

D. Provide filter of sufficient size to minimize back-pressure.

E. The system shall be provided with desiccant dryer sized for peak calculated demand and produces a 10° F (-12° C) pressure dew point.

F. Pressure Reducing Regulators

G. All components factory packaged (pre-wired and prepaid), on a steel base, or tank mounted. Provide discharge separator/silencer.

H. The system shall have a touch screen control with Ethernet connectivity and embedded web page for remote monitoring.

PART 3 - Execution

3.1 Installation

A. The system shall be installed to allow adequate services space and replacement of unit.

B. Special attention shall be made for placement of the unit due to the acoustical challenges.

C. Provide adequate ventilation or condition air to meet the manufacture's operating requirements.

3.2 Testing

A. Provide factory Startup and testing.

END OF SECTION 22 61 19

SECTION 22 62 13 – LABORATORY VACUUM PIPING

PART 1 - General

1.1 Reference Standards

A. B16.22-80 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

B. B40.1-85 - Gauges-Pressure Indicating Dial Type-Elastic Element.

C. NFPA 99 - Latest edition

D. Copper Tubing: Type "K" or "L", ASTM B819, copper tube, hard drawn temper, with wrought copper fittings conforming to ANSI B16.22 and brazed joints,

E. Comply with American Society of Mechanical Engineers (ASME)code standards

F. ASTM B88, ANSI B16.22.

1.2 Warranty

A. Provide a one-year warranty on piping from the date of substantial completion of construction.

PART 2 - Products

2.1 Manufacturers

A. Mueller

B. Wolverine

2.2 Equipment & Materials

A. The Copper pipe shall Type "K" or "L"

PART 3 - Execution

3.1 Installation

A. Clean pipe valves and fittings as required by NFPA 99, Latest edition.

B. Do not bend tubing.

C. Rigidly support pipe to prevent strain on or joints.

D. Spacing of Hangers: NFPA 99, Latest edition.

3.2 Testing

A. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.

B. Blow down, and high and low pressure leakage tests as required by NFPA 99 – Latest edition, with documentation.

END OF SECTION 22 62 13

SECTION 22 62 19 – LABORATORY VACUUM EQUIPMENT

General

1.1 Reference Standards

A. ASME Section VIII.

B. American Society of Mechanical Engineers (ASME):

C. ASTM B88, ANSI B16.22.

1.2 Warranty

A. Provide a 5-year warranty from the date of substantial completion of construction.

Products

1.3 Manufacturers

A. Beacon

B. Republic Manufacturing

1.4 Equipment & Materials

A. Duplex laboratory central vacuum system shall consist of two oil lubricated rotary vane vacuum pumps with a horizontal or vertical ASME coded receiver with automatic alternating electrical controls.

B. Each Pump shall be direct-drive, flooded oil rotary vane type, with filtered total oil re-circulation, capable of providing a maximum vacuum level of 28-inches Hg.

C. Each pump is air-cooled pump with absolutely no water requirements.

D. Each pump includes a built-in, anti-suck-back valve mounted at the pump inlet.

E. Receiver Tank shall be welded steel and constructed in compliance with ASME Section VIII, 200 PSIG working pressure stamped and certified.

F. Each vacuum pump shall be equipped with an automatic purge system to flush any gases from the pump to prevent condensation as the pump cools.

G. Receiver Tank shall be equipped with a 10-micron inlet filter for removal of particulates.

H. Receiver Tank shall have threaded exhaust adapter to permit piping of the exhaust gases to a remote point.

I. All components factory packaged (pre-wired and prepaid), on a steel base, or tank mounted. Provide discharge separator/silencer.

J. vacuum system shall be equipped with an automatic alternating electrical control center that is UL listed.

Execution

K. Install the vacuum system on a housekeeping pad.

1.5 Testing

A. Initial start-up shall be performed by the manufacturer's representative.

END OF SECTION 22 62 19

SECTION 22 66 53 - LABORATORY CHEMICAL-WASTE AND VENT PIPING

PART 1 - General

1.1 Reference Standards

A. All polypropylene piping shall conform to the requirements of DIN 8077 and ASTM D 2837 for hydrostatic design basis.

B. All borosilicate glass piping shall conform to the requirements of ASTM standards.

1.2 Warranty

A. Provide a 1-year warranty from substantial completion date of construction.

PART 2 - Products

2.1 Manufacturers

A. Orion

B. Chemtrol

C. IPEX

D. Town & country Plastics

2.2 Equipment & Materials

A. Piping Material shall be made from chemically-resistant NSF listed and CSA certified Schedule 40, polypropylene system.

B. Pipe shall be made from NSF listed Type 1, flame retardant polypropylene conforming to ASTM D4101.

C. Fittings shall be NSF listed and have an integral heavy gauge, nickel/chrome electrical resistance wire molded in place in the fitting body. Copper wire elements, loose wire or other loose joint components, are prohibited.

D. All socket fusion natural polypropylene and fittings shall be joined in accordance with ASTM D 2657.

PART 3 - Execution

3.1 Installation

A. All fabrication and installation to be in accordance with piping Manufacturer's Installation Manual.

B. Support spacing shall be in accordance with the manufacturer’s recommendations. Vertical piping shall have riser clamps at each floor.

3.2 Testing

A. Test piping system in accordance with manufacturer's recommendations and local code requirements.

PART 4 - END OF SECTION 22 66 53

SECTION 22 66 83 – CHEMICAL-WASTE DILUTION TANKS

PART 1 - General

1.1 Reference Standards

A. All polypropylene tanks shall conform to the requirements of DIN 8077 and ASTM D 2837 for hydrostatic design basis.

B. Chemically resistance ceramic tank shall conform to the ASTM and ANSI standards.

1.2 Warranty

A. Provide a 1-year warranty from substantial completion date of construction.

PART 2 - Products

2.1 Manufacturers

A. Orion.

B. Park

C. IPEX

D. Town & country Plastics

E. Zurn

2.2 Equipment & Materials

A. Chemically-resistant Polypropylene tank can be used only if approved by the local Authority having jurisdiction. All socket fusion natural polypropylene and fittings shall be joined in accordance with ASTM D 2657.

B. Lime stones chips or marbles chips are used to neutralize the acids.

C. Neutralization charge supplied by basin manufacturer.

PART 3 - Execution

3.1 Installation

A. Sump shall be supplied and installed with neutralizing charge.

B. Provide and install manhole extension for exterior locations.

C. All fabrication and installation to be in accordance with Manufacturer's Installation Manual and recommendations.

3.2 Testing

A. The effluent discharge pH analysis shall be performed and the results shall satisfy the minimum requirements as approved by the local authorities having jurisdiction.

END OF SECTION 22 66 83

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

23 00 01	Mechanical Design General Guidelines
23 00 02	Design Review Requirements
23 00 03	Mechanical Acceptable Manufacturers
23 00 06	Central Plant Design Guidelines
23 00 07	Design Criteria
23 00 09	HVAC Requirements
23 20 00	HVAC Piping and Pumps
23 31 00	HVAC Ducts
23 34 00	HVAC Fans
23 36 00	Air Terminal Units
23 73 00	Central HVAC Equipment

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 00 01 - MECHANICAL DESIGN GENERAL GUIDELINES

PART 1 - Introduction

1.1 Purpose and Scope

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 Energy Efficiency and Life Cycle Cost Considerations (LCC)

A. Provide mechanical systems based on achieving the lowest life cycle cost of approved alternatives. Minimum of 3 HVAC system alternatives should be presented at the 35% design stage with associated life cycle costs. A recommendation should be provided and approved prior to proceeding to subsequent submittal.

B. The design team should also be conscious of design decisions with regard to sustainable design. Although ACCD does not require LEED (Leadership in Energy and Environmental Design) certification, ACCD requires implementing design that is environmentally friendly. LEED Checklist shall be provided at every design submittal.

C. Energy Use Intensity (EUI) should be compared to buildings of similar type

D. Energy meters shall be provided to all energy supplies to building and report to the Building Automation System (BAS)

E. The following strategies shall be evaluated for design implementation:
1. DDC controls to monitor and optimize equipment efficiency
2. Economizer cycle operation during times when outdoor air enthalpy is below return air enthalpy
3. Air to Air heat recovery to pre-condition outside air during times when economizer is inoperative. Select heat recovery equipment with no moving parts.
4. Hot water reset
5. Supply air temperature reset.
6. Variable speed drive on pumps
7. Electronically Commutated Motor (ECM) or Variable speed drive on fans.
8. Demand-based ventilation control (CO2 sensors in high occupancy areas)
9. Occupied/unoccupied temperature reset strategies
10. Early strategic planning of location of mechanical equipment and distribution shafts
11. Thermal energy storage for chillers to shave peak demand

1.3 Maintainability

A. Mechanical rooms should be designed to facilitate maintenance. Equipment should be selected for reliability and based on a minimum of 3 manufacturers. Catalog cut-sheets must be included in the design analysis. Mechanical rooms should be designed to house the equipment from any of the three manufacturers with adequate space for maintainability, accessibility and replacement. Doors to room should be sized to facilitate equipment removal and a clear path should be allocated from equipment to door for replacement. Accessibility and maintainability should also be designed for the piping, valves, and control elements associated with the equipment. Design should also include features necessary for flushing hydronic system, testing, adjusting and balancing, and system commissioning.

B. All equipment should be located in mechanical rooms except for small condensing units and exhaust fans.

1.4 Commissioning - ACCD will assign a commissioning agent for the project.

PART 2 - Modification of Existing Facilities

2.1 Site Investigation - Designers shall conduct thorough site investigations of existing facilities to be upgraded or modified. Designers are required to inspect all equipment rooms and above ceiling conditions to establish existing conditions.

2.2 Modifications to existing systems shall be shown and described in design documents. Phasing drawings shall include, if required, temporary connections and measures necessary to sustain service. If service is to be altered or interrupted, duration of interruption should be discussed with ACCD during design.

2.3 Existing ductwork, piping, equipment, controls etc. that will not serve any purpose shall be removed. Coordinate any equipment to be salvaged with ACCD.

2.4 Equipment should be located in mechanical rooms except for small condensing units and exhaust fans. If limited space conditions do not permit locating equipment in mechanical rooms, equipment may be located on roof provided adequate access for maintainability. Access to roofs by portable ladder is not acceptable. Roof mounted mechanical equipment must be housed in a building. Exceptions for roof mounted equipment must be approved by ACCD.

END OF SECTION 23 00 01

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 00 02 - DESIGN REVIEW REQUIREMENTS

PART 1 - Design Analysis

1.1 Provide a design analysis at every submittal

1.2 Design analysis shall contain the following information as applicable to submittal:

- a. Basis of design
  - 1) Indoor and outdoor design conditions
  - 2) Ventilation rates
  - 3) Pressurization criteria
  - 4) Noise criteria
- b. Building heating and cooling load calculations
- c. Psychrometric calculations
- d. Calculations supporting equipment selection
- e. Sizing calculations - duct, piping, etc
- f. Equipment cut-sheets
- g. Criteria and codes
- h. Site conditions - i.e. energy sources and availability, etc
- i. System alternatives and selection
- j. Energy calculations as per latest version ASHRAE 90.1
- k. LEED Checklist

PART 2 - Preliminary Concept Submittal

2.1 New Campus Alternatives

A. New Campus or buildings which are stand-alone (not receiving chilled water, hot water, and/or steam from a campus distribution loop) - Designer shall assess mechanical systems based on achieving the lowest life cycle cost of approved alternatives. Minimum of 3 system alternatives should be presented at the preliminary concept design stage with associated life cycle costs. A recommendation should be provided and approved prior to proceeding to subsequent submittal.

B. Provide working level documents indicating three system types with Life Cycle costs and recommendations. Documents are only to be developed to the level required that so that a selection can be made within program operation and budget goals.

2.2 Existing Campus

A. New Building - Designer shall meet with ACCD and verify capacity, connection points and sizes. Designer shall provide projected loads on campus infrastructure and verify adequate capacity for new project.

B. Existing Building - Designer shall verify HVAC system capacity will support projected loads.

C. Provide design analysis.

PART 3 - Schematic Design (35%)

3.1 For the system approved and selected, provide the following where applicable:

A. Drawings - New Work
1. HVAC Systems with one line diagram of distribution system. Distribution mains shall be dimensioned. Indicate location of terminal units
2. Mechanical room and/or roof plans showing major equipment. Indicate access to equipment and maintenance clearance requirements. Mechanical rooms shall be drawn at 1/4" = 1'-0"

B. Demolition Drawings

C. Major Equipment Schedules

D. Details

E. Flow Diagrams
1. Airflow diagrams for supply, return, outside air and exhaust systems
2. Water flow diagrams
3. Steam flow diagrams

F. Design Analysis

G. Outline specifications

PART 4 - Design Development (65%)

4.1 For the system approved and selected, provide the following where applicable:

A. Drawings - New Work

1. HVAC Systems with one line diagram of distribution system to air devices. All ductwork shall be dimensioned. Indicate location of terminal units
2. Hydronic piping distribution with sizes on mains. Indicate isolation valves at all major branches.
3. Mechanical room at 1/4" = 1'-0". All mechanical equipment, double line ductwork and piping shall be shown. Indicate access to equipment and maintenance clearance requirements.

B. Roof Plan - indicate equipment on roof plan and access to roof equipment. No roof ductwork and piping should be located on new building construction. Roof ductwork and piping should be limited in existing construction.

C. Demolition Drawings

D. Equipment Schedules
1. Chillers
2. Boilers
3. Heat exchangers
4. Pumps
5. Cooling towers
6. Air handling units
7. Computer room air conditioners
8. Fan coil units
9. Terminal units
10. Air devices
11. Air balance relationships between spaces

E. Details

F. Flow Diagrams
1. Airflow diagrams for supply, return, outside air and exhaust systems. Indicate balancing quantities and devices
2. Water flow diagrams. Indicate balancing quantities and devices.
3. Steam flow diagram. Indicated flow quantities.

G. Control drawings with sequence of operation

H. Phasing Drawings

I. Design Analysis

J. Edited Specifications

PART 5 - Construction Documents (100%)

5.1 For the system approved and selected, provide the following where applicable:

A. Drawings - New Work
1. HVAC Systems with double line ductwork with sizes. Drawings should indicate bottom of ductwork elevation which is coordinated with structure and other trades. Drawings should indicate access requirements for equipment, i.e. terminal box coils, controls, valves, etc.
2. Hydronic piping distribution with size. Indicate isolation valves at all major branches and means for flushing system. All piping shall indicate centerline of piping elevation which is coordinated with ductwork, structure and other trades.
3. Mechanical room plans, sections and elevations at 1/4" = 1'-0". All mechanical equipment, double line ductwork and piping shall be shown. Indicate access to equipment and maintenance clearance requirements. Indicate all valves and control devices.
4. Drawings shall indicate location of control sensors and devices.

B. Roof Plan - indicate equipment on roof plan and access to roof equipment. No roof ductwork and piping should be located on new building construction. Roof ductwork and piping should be limited in existing construction.

C. Demolition Drawings

D. Equipment Schedules
1. Chillers
2. Boilers
3. Heat exchangers
4. Pumps
5. Cooling towers
6. Air handling units
7. Computer room air conditioners
8. Fan coil units
9. Terminal units
10. Air devices
11. Air balance relationships between spaces

E. Details

F. Flow Diagrams
1. Airflow diagrams for supply, return, outside air and exhaust systems. Indicate balancing quantities and devices
2. Water flow diagrams. Indicate balancing quantities and devices.
3. Steam flow diagram. Indicated flow quantities.

G. Control drawings with sequence of operation. Control drawings should indicate all sensors, valves, dampers, detectors, etc.

H. Phasing Drawings

I. Design Analysis

J. Edited Specifications

PART 6 - Drawing Requirements

6.1 Drawings must be accurate and to scale. Drawings shall be produced in the latest version of Revit. Revit and bound CAD files shall be provided with final drawings. (COORDINATE WITH ARCH)

6.2 One bookmarked PDF file containing all mechanical drawings with hyperlink table of contents shall be provided at every submittal.

END OF SECTION 23 00 02

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 00 03 - MECHANICAL ACCEPTABLE MANUFACTURERS

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

PART 2 - Products

2.1 Manufacturers – 23 05 16 – Expansion fittings and Loops for HVAC Piping

A. Adsco

B. Advanced Thermal Systems.

C. Flexicraft

D. Hyspan

2.2 Manufacturers – 230519 – Meters and Gages for HVAC Piping

A. Thermometers & Air Pressure Gages
   1. Ashcroft.
   2. Wika
   3. Trerice
   4. Weiss

B. Water Pressure Gages
   1. Ashcroft.
   2. Wika
   3. Trerice
   4. Weiss

C. Steam Pressure Gages
   1. Ernst
   2. Orange Research
   3. Trerice

4. Weiss.

2.3 Manufacturers – 23 05 23 – General Duty Valves for HVAC Piping

A. Gate and Globe Valves
   1. Clow
   2. Hammond
   3. Kennedy
   4. Milwaukee

B. Check Valves
   1. Centerline.
   2. Clow.
   3. Hammond
   4. Resistoflex

C. Ball Valves
   1. Apollo
   2. Hammond
   3. Jamesbury
   4. Kennedy

D. Butterly Valves
   1. Centerline
   2. Grinnell
   3. Hammond
   4. Jamesbury

E. Circuit Balancing Valves
   1. Armstrong
   2. Flow Set
   3. Nexu
   4. Nibco

F. Plug Valves
   1. Armstrong.
   2. Grinnell.
   3. Nordstrom.
   4. Stockham.

2.4 Manufacturers – 23 05 29 – Hanger and Supports for HVAC Piping and Equipment

A. B-Line

B. I.T.T. Grinnell

C. Michigan Hanger

D. PHD.

2.5 Manufacturers – 23 05 33 – Heat Tracing for HVAC Piping

A. Chromalox

B. Raychem

C. Thermon

2.6 Manufacturers – 23 05 48 – Vibration and Seismic Controls for HVAC Piping Equipment

A. Amber-Booth Company.

B. Consolidated Kinetics.

C. Kinetics Noise Control.

D. Mason Industries.

2.7 Manufacturers – 23 05 53 – Identification for HVAC Piping and Equipment

A. Brady

B. Metalcraft

C. Panduit

D. Seton

2.8 Manufacturers – 23 05 93 – Testing, Adjusting and Balancing for HVAC

A. Air Technologies, Inc.

B. Engineered Air Balance.

C. Energy Testing & Balance, Inc.

D. Mechanical Performance, Inc.

2.9 Manufacturers – 23 07 13 – Duct Insulation

A. Duct Insulation
1. Armstrong.
2. CertainTeed
3. IMCOA(IMCOLOCK, IMCOSHIELD)
4. Knauf.

B. Adhesives
1. 3M
2. Childers
3. Foster
4. IMCOA-FUSE_SEAL SYSTEM

2.10 Manufacturers – 23 07 16 – HVAC Equipment Insulation

A. Duct Insulation
1. Armstrong
2. CertainTeed
3. IMCOA (IMCOLOCK, IMCOSHIELD)
4. Knauf

B. Adhesives
1. 3M
2. Childers
3. Foster
4. IMCOA-FUSE_SEAL SYSTEM

2.11 Manufacturers – 23 07 19 – HVAC Piping Insulation

A. Duct Insulation
1. Armstron
2. CertainTeed
3. IMCOA (IMCOLOCK, IMCOSHIELD)
4. Knauf

B. Adhesives
1. 3M.
2. Childers.
3. Foster.
4. IMCOA-FUSE_SEAL SYSTEM.

2.12 Manufacturers – 23 09 23 – HVAC Control Systems

A. Automated Logic

B. Computrols.

C. Yates

D. Honeywell

E. Johnson Controls

2.13 Manufacturers – 23 21 13.13 – Diagnostic Systems for HVAC Control Systems

A. Insul-Pipe Systems

B. Perma-Pipe

C. Thermacor Process, Inc.

2.14 Manufacturers – 23 21 13.13 – Underground Hydronic Piping

A. Insul-Pipe Systems

B. Perma-Pipe

C. Thermacor Process, Inc.

2.15 Manufacturers – 23 21 23.13 – In-Line Centrifugal Hydronic Pumps

A. Aurora.

B. Ingersoll-Rand

C. ITT Allis-Chalmers

D. ITT Bell & Gossett

2.16 Manufacturers – 23 21 23.16 – Base-Mounted, Centrifugal Hydronic Pumps

A. Aurora

B. Ingersoll-Rand

C. ITT Allis-Chalmers

D. ITT Bell & Gossett

2.17 Manufacturers – 23 21 23.23 – Horizontal Split Case Double-Suction Centrifugal Hydronic Pumps

A. Aurora

B. Ingersoll-Rand

C. ITT Allis-Chalmers

D. ITT Bell & Gossett

2.18 Manufacturers – 23 22 13 – Steam and Condensate Heating Piping

A. Steam Traps
   1. Armstrong
   2. Clark-Reliance
   3. Hoffman
   4. Sarco

B. Pressure Reducing Stations
   1. Fisher
   2. Leslie
   3. Spence
   4. Watts

C. Steam Relief Valves
   1. Conbraco
   2. Crane
   3. Kunkel
   4. Keckly

2.19 Manufacturers – 23 22 23 – Steam Condensate Pumps

A. Armstrong

B. Burks

C. Chicago

D. Skidmore

2.20 Manufacturers – 23 23 19 – Refrigerant Safety Relief Valve Discharge Piping

A. Carrier

B. McQuay

C. Trane

D. York

2.21 Manufacturers – 23 25 13 – Water Treatment for Closed-Loop Hydronic Systems

A. Betz Dearborn

B. Mogul

C. Nalco

2.22 Manufacturers – 23 25 16 – Water Treatment for Open Hydronic Systems

A. Betz Dearborn

B. Hydro Systems, Inc

C. Mogul

D. Nalco

2.23 Manufacturers – 23 33 13.13 – Volume Control Dampers

A. American Warming and Ventilating.

B. Greenheck.

C. Louvers & Dampers, Inc.

D. Ruskin.

2.24 Manufacturers – 23 33 13.16 – Fire Dampers

A. Air Balance, Inc.

B. American Warming and Ventilation Company.

C. Greenheck.

D. Nailor Industries, Inc.

2.25 Manufacturers – 23 33 13.19 – Smoke Control Dampers

A. Greenheck

B. Prefco

C. Ruskin

2.26 Manufacturers – 23 33 13.23 – Backdraft Dampers

A. American Warming and Ventilating.

B. Greenheck

C. Louvers & Dampers Inc.

D. Ruskin.

2.27 Manufacturers – 23 33 19 – Duct Silencers

A. Industrial Acoustics Co., Inc. (IAC)

B. Rink Sound Control

C. Semco

D. Transonic, Inc. (TSI)

2.28 Manufacturers – 23 33 33 – Duct Mounted Access Doors

A. Duro Dyne

B. Duct Mate

C. Flexmaster

2.29 Manufacturers 23 33 43 – Flexible Connectors

A. Ventfabrics

B. DuroDyne

2.30 Manufacturers 23 33 46 – Flexible Ducts

A. Flexmaster

2.31 Manufacturers 23 34 13 – Axial HVAC Fans

A. Acme

B. Cook

C. Greenheck

2.32 Manufacturers 23 34 16 – Centrifugal HVAC Fans

A. Acme

B. Cook

C. Greenheck

D. Twin City

2.33 Manufacturers – 23 34 19 – In-Line Centrifugal Fans

A. Acme.

B. Cook.

C. Greenheck

2.34 Manufacturers – 23 34 23 - HVAC Power Ventilators

A. Acme.

B. Cook.

C. Greenheck

2.35 Manufacturers – 23 34 33 – Air Curtains

A. Berner International Corp.

B. Greenheck

C. Leading Edge

D. Mars

2.36 Manufacturers – 23 36 13 – Series Flow Fan Powered Terminal Units

A. Enviro-Tec

B. Krueger

C. Metal-Aire

D. Price

2.37 Manufacturers – 23 36 16 – Variable Air Volume Units

A. Enviro-Tec

B. Krueger

C. Metal Aire

D. Price

2.38 Manufacturers – 23 37 00 – Air Outlets and Inlets

A. Acme

B. Cook

C. Greenheck

2.39 Manufacturers – 23 37 13 – Diffusers, Registers and Grilles

A. Krueger

B. Metal Aire

C. Price

D. Titus

2.40 Manufacturers – 23 41 13 – Panel Air Filters

A. American Air Filter

B. Cambridge

C. Continental

D. Farr

2.41 Manufacturers – 23 41 23 – Extended Surface Air Filters

A. American Air Filter

B. Cambridge

C. Continental

D. Farr

2.42 Manufacturers – 23 52 13 – Electric Steam Boilers

A. Bryan

B. Fulton

2.43 Manufacturers – 23 52 33 – Water Tube Boilers

A. Ajax

B. Rite

2.44 Manufacturers – 23 52 39 – Fire-Tube Boilers

A. Bryan

B. Burnham Industrial

C. Cleaver Brooks.

D. Hurst.

2.45 Manufacturers – 23 53 16 – Boiler Feedwater Equipment

A. Shipco

B. Bryan

C. Burnham

2.46 Manufacturers – 23 57 16 – Steam to Water Heat Exchangers

A. Amtrol

B. Bell & Gossett

C. Dunham-Bush

D. Patterson Kelley

2.47 Manufacturers – 23 57 19.13 – Plate Type, Liquid to Liquid Heat Exchangers

A. Alfa-Laval

B. Tranter

C. Graham

2.48 Manufacturers – 23 57 19.16 – Shell Type, Liquid to Liquid Heat Exchangers

A. Amtrol

B. Bell & Gossett

C. Dunham-GBush

D. Patterson-Kelley

2.49 Manufacturers – 23 62 13 – Packaged Air Cooled Chillers

A. Carrier

B. Trane

C. York

2.50 Manufacturers – 23 64 16 – Centrifugal Water Chillers

A. Carrier

B. McQuay

C. Trane

D. York

2.51 Manufacturers – 23 64 23 – Scroll Water Chillers

A. Carrier

B. Trane

C. York

2.52 Manufacturers – 23 64 26 – Rotary Screw Water Chillers

A. Carrier

B. Trane

C. York

2.53 Manufacturers – 23 65 13.13 – Open-Circuit Forced Draft Cooling Towers

A. Marley Cooling Tower Co.

B. Evapco Inc.

C. Baltimore Air Coil

2.54 Manufacturers – 23 65 23 – Field Erected Cooling Towers

A. Baltimore Air Coil.

B. Marley Cooling Tower Co.

2.55 Manufacturers – 23 72 13 – Heat wheel Air-to-Air Energy Recovery Equipment

A. AnnexAir

B. Greenheck

C. Semco

D. York

2.56 Manufacturers – 23 73 13.13 – Indoor Indirect Fired Heating and Ventilating Units

A. Carrier

B. Greenheck

C. McQuay

D. Modine

2.57 Manufacturers – 23 73 23 – Custom Indoor Central Station Air Handling Units

A. Buffalo

B. Haakon

C. Marcraft

D. Pace

2.58 Manufacturers – 23 74 13 – Packaged Outdoor Central Station Air Handling Units

A. Carrier

B. McQuay

C. Temtrol

D. Trane

2.59 Manufacturers – 23 74 16 – Packaged Outdoor Air Conditioning Units

A. Carrier

B. McQuay

C. Temtrol

D. Trane

2.60 Manufacturers – 23 81 19 – Self- Contained Air Conditioners

A. American Air Filter

B. Carrier

C. General Electric

2.61 Manufacturers – 23 81 23 – Computer-Room Air Conditioners

A. Carrier

B. Data Aire

C. Liebert

2.62 Manufacturers – 23 81 26 – Split System Air Conditioners

A. Carrier

B. McQuay

C. Trane

D. York.

2.63 Manufacturers – 23 81 45 – Variable Refrigerant Flow

A. Trane

B. Daikin

C. Mitsubishi

2.64 Manufacturers – 23 82 16 – Air Coils

A. Aerofin

B. Carrier

C. Heatcraft

D. McQuay

2.65 Manufacturers – 23 82 19 – Fan Coil Units

A. Carrier

B. Enviro-Tex

C. International Environmental

D. McQuay

2.66 Manufacturers – 23 82 23 – Unit Ventilators

A. Air Filter

B. Trane

2.67 Manufacturers – 23 82 39.23 – Hot Water Unit Heaters

A. McQuay

B. Modine

C. Reznor

D. Trane

2.68 Manufacturers – 23 84 19 – Indoor Pool and Dehumidification Units

A. Desert Aire

B. Dumont

C. Pool Pak

2.69 Manufacturers – 26 29 23 – Variable Frequency Drives

A. Trane

B. ABB

C. Dan Foss

D. Yaskawa

PART 3 - Execution

Not Applicable.

END OF SECTION 23 00 03

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 00 06 - CENTRAL PLANT DESIGN GUIDELINES

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 Requirements

A. Engineer shall perform Life Cycle Cost Analysis (LCCA) for the following chiller types
   1. Centrifugal Chillers
   2. Rotary Screw Chillers
   3. Magnetic Bearing Chillers

B. Preferable to have a variable primary distribution chilled water system. Alternates will be considered with supporting LCCA.

C. Provide LCCA option using thermal energy storage for ice storage to shave peak demand.

D. Each chiller will have a dedicated chilled water pump, condenser water pump, and cooling tower.

E. Chillers cooling towers and pumps shall be in an N+1 redundancy so that failure of the largest component will not compromise the delivery of chilled or condenser water.

F. Provide external valved connections and physical space for a back-up chiller.

G. Accommodate future expansion by providing physical space for new equipment and piping pathways for thermal media including chillers, cooling towers, and anticipated pumps within the footprint of the central energy plant.

H. Provide marine water boxes for chillers to enable cleaning, tube inspection, and tube replacement without removing the interconnecting pipe work.

I. Plans should indicate space for equipment servicing and removal

J. Coordinate with structural to provide overhead hoist to remove large chiller components for servicing. Hoist should move on 2 axis, i.e. north-south and east-west.

K. Chilled water pumps shall be piped to allow any pump to serve any chiller

L. Condenser water pumps shall be piped to allow any pump to serve any chiller

M. Cooling towers shall be piped to allow any pump to serve any chiller

N. Controls should allow Building Automation System (BAS) means of measuring flow and, chilled water temperatures. Controls shall automatically enable/disable equipment in response to loads in the most energy efficient sequence.

O. Provide service sink

P. Provide adequate floor drains next to equipment.

PART 2 - Products

2.1 Chillers

A. Chillers shall be selected at the following conditions. Types of chillers and their specific requirements shall be as required in the guide specifications.

Evaporator	Condenser
LWT 44°F EWT 56°F	LWT 95°F EWT 85°F
F.F. .0005	F.F. .001
PASSES 2	PASSES 2

B. Water Velocity - 10 FPS (MAX)

2.2 Water Cooled Centrifugal Chillers

A. Minimum efficiency requirements: 0.53 kw/ton full load (at AHRI) and 0.42 kw/ton (IPLV)

B. Next Generation refrigerants (HFO's) should be used in all chillers greater than 300 tons. HFC- 134a and HCFC-123 will not be acceptable for projects turned over to the owner in January 2019 and beyond.

C. Chillers with variable speed drives shall be refrigerant cooled. If water cooled drives are utilized, they shall be provided with cleanable, shell and tube style heat exchangers and not plate and frame heat exchangers. Water cooled drives shall include tube brushing maintenance by the manufacturer for the first 5 years of operation on an annual basis.

D. Warranty shall be 5 years minimum to include parts, labor and all refrigerant (including during service). The owner will not be responsible for any additional costs except for preventative

maintenance. Refrigerant loss as part of normal operation or servicing of the chiller shall be covered.

E. For low pressure machines, provide a purge capable of removing air at an efficiency rate of 99.997%.

F. Central plant design must comply with Ashrae Standard 15. Where new or replacement chillers are added to the existing plant, the engineer of record must survey the existing installation to insure full compliance with the code.

G. Where condenser anodes are currently installed on the existing chillers, they shall be added to the new chillers.

H. Prior to start-up, the manufacturer shall perform an eddy current of the evaporator and condenser tubes for a base line. Any defective tubes shall be replaced.

I. Where space allows, the condenser shall be provided with marine water boxes with hinges on both ends for ease of service.

J. Provide short circuit withstand rating of 65k amps for unit mounted starters.

K. Provide Open Protocol (must be either Lon or BacNet) to communicate with the existing control infrastructure.

2.3 Cooling Towers

A. Cooling towers shall be stainless steel

B. Preferable to have induced draft, cross flow, vertical discharge with self-extinguishing PVC fill and eliminators.

C. Cooling towers shall be selected at the following conditions. Types of towers and their specific requirements shall be as required in the guide specifications:

GPM	3GPM/Ton
LWT	85°F
EWT	95°F
WBT	78°F

D. Location should consider noise, drift, prevailing winds elevation relative to condenser water pumps, and proximity to building outdoor air intakes.

E. Provide direct drives and variable speed motor controllers.

F. Provide multi-celled towers with concrete basins

2.4 Water treatment

A. Water treatment equipment shall be located over a pit filled with crushed limestone. Provide a suitable fiberglass grating of sufficient strength over top of pit. Provide an emergency shower and eyewash adjacent to treatment equipment.

PART 3 - Execution

3.1 Installation:

A. Mount equipment on concrete housekeeping pads. Housekeeping pad shall be 4" overall longer and wider than equipment supported

END OF SECTION 23 00 06

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 00 07 DESIGN CRITERIA

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 Requirements

A. Outdoor Design Conditions
   a. Summer: 100 deg.F DB - 78. deg. F WB
   b. Winter: 20 deg.F

B. Indoor Design Conditions
   1. Classrooms, Libraries, Offices, Administrative:
      a. Summer: 72 deg. F DB - 50% RH
      b. Winter: 72 deg. F DB
   2. Kitchens:
      a. Summer: 78 deg.F DB
      b. Winter :70 deg.F
   3. Showers:
      a. Summer: 78 deg.F DB
      b. Winter: 78 deg.F

C. Ventilation rates shall be according to latest edition of ASHRAE 62.1

D. The following areas shall have 100% exhaust of supply air to outdoors and negatively pressurized with respect to adjacent areas:
   1. Animal Research
   2. Showers
   3. Dark Rooms
   4. Janitors Closets
   5. Kitchens
   6. Laboratory Areas
   7. Gas Storage Rooms
   8. Flammable Storage rooms
   9. Toilet Rooms

E. Room maximum noise criteria = 35 unless otherwise noted

Space	(NC)
Auditoriums	30
Classrooms	30
Corridors and Public Areas	40
Executive Offices	30
Laboratories	40
Libraries	30

PART 2 - Products

2.1 Not Applicable

PART 3 - Execution

3.1 Not Applicable

END OF SECTION 23 00 07

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 00 09 - HVAC REQUIREMENTS

PART 1 - General Requirements

1.1 Following air systems shall be considered for distribution systems

A. Dedicated Outdoor Air Ventilation System (DOAS) supplies dehumidified and reheated (tempered to room DB temperature) 100 percent outside air directly to all spaces when occupied. The system must provide the capability to condition ventilation air not to exceed 55°F dewpoint over the full range of cooling load. Size the DOAS to handle both the ventilation and zone generated latent loads

B. Single duct variable air volume

C. Double duct variable air volume systems in existing construction

1.2 Air flow measurement

A. Provide honey comb airflow straightener and access door upstream of airflow measuring station (AFMS). Access door shall be between straightener and AFMS, minimum distance between straightener and AFMS shall be 18”

B. Provide Ebtron gold series AFMS

1.3 Provide unobstructed 5 duct or pipe diameters to ensure proper flow measurements. Following systems shall be Tested, adjusted and balanced

1. Supply Air
2. Return Air
3. Relief Air
4. Outside air
5. Exhaust Air
6. Chilled Water
7. Hot Water
8. Condenser Water

1.4 Mechanical rooms shall not be plenumized. Mechanical rooms located over occupied spaces should have a curb at the perimeter and around all penetrations to avoid water leaking to space below.

1.5 Barometric dampers shall not be used as a form of relief for an air handling system. System shall

be provided with return fan or relief fan that is part of the control sequence.

1.6 Noise vibrations to adjoining spaces should be addressed in the design. Lab exhaust fans and air handling units located on roof should be placed on vibration isolators and supported from columns to avoid noise transmission to space below

1.7 Air Devices

A. Supply air devices shall be louvered or slot diffusers in occupied areas.

B. Return air devices shall be eggcrate. Provide duct boots as required for noise attenuation

1.8 Variable Frequency Drive

A. Review with the local facility director of the respective campus if bypass is required. Where bypass is required, 2 contactor bypass with main fused disconnect is acceptable.

B. Provide BacNet (or LON) interface to the Energy Management system.

C. Provide 3 year parts and labor warranty.

PART 2 - Special HVAC Requirements

2.1 Laboratories

A. Designer should consider variable air volume controls for laboratory as a means of energy conservation.

B. Phoenix control valves or similar should be used to measure and control laboratory airflow. Noise and pressure drop from valves should be addressed in the laboratory design

C. Laboratory exhaust fans shall be high plume dilution fans. No vent sets are allowed. Roof design should be coordinated to eliminate noise vibration to the spaces below.

D. Coordinate location of laboratories with architect at early stages to avoid placing on external walls and prevent negative pressure air infiltration.

E. Provide reduced flow for non-occupied hours

F. Provide means for conditioned make-up air for 24/7 operation.

2.2 MDF/IDF Rooms

A. Provide terminal unit with no reheat to room as primary source of cooling

B. Provide fan coil or computer room air conditioner for after-hours cooling

C. No pipes shall be located over MDF/IDF equipment

2.3 Stand-Alone buildings which are not served by a central energy plant

A. Provide air cooled chiller
   1. Unit shall have 5 year parts and labor refrigerant warranty
   2. Provide unit mounted disconnect or circuit breaker with short circuit withstand rating of 65k amps for unit mounted starters.
   3. Provide Open Protocol (must be either Lon or BacNet) to communicate with the existing control infrastructure.
   4. Provide Dual independent refrigerant circuits
   5. Review acoustical requirements for the location to determine what, if any, special conditions might exist for each installation. Review with the local campus facility director

B. Variable refrigerant flow system shall be considered
   1. Provide ventilation air to meet both ASHRAE 62.1 requirements and latent heat requirements
   2. Provide heat recovery system. Heat pump systems are not acceptable.
   3. Provide BacNet interface into campus energy wide management system.
   4. Provide 2 year parts and labor with 3rd thru 10th year parts only warranty for the entire VRF system as minimum level of quality.
   5. Do not exceed a 120% combination ratio for diversity without providing the local facility director with specific information on why this is necessary.

END OF SECTION 23 00 09

SECTION 23 20 00 - HVAC PIPING AND PUMPS

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 References

A. ASME Compliance: Fabricate and install hydronic piping in accordance with ASME B31.9 "Building Services Piping"

B. HI Compliance: Design, manufacture, and install pumps in accordance with HI "Hydraulic Institute Standards."

C. UL Compliance: Design, manufacture, and install pumps in accordance with UL 778 "Motor Operated Water Pumps."

D. NEMA Compliance: Provide electric motors and components which comply with NEMA standards.

1.3 Requirements

A. Provide means for access where valves and fittings are not exposed.

B. Chilled water systems serving secondary loads shall be independently circuited from the primary chilled water system within the building and serve mechanical systems such as standalone computer HVAC, refrigeration equipment, etc.

C. Chilled water design supply water temperature shall be 42 degrees F, with a minimum return water temperature of 58 degrees F to maximize the usable lifetime (optimize pipe size of existing piping) of water systems. This shall be accomplished without the use of blending stations.

D. Provide supply side sectional valve and return side calibrated balancing valves on each branch and riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections

E. Provide drain valves on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser or drop in piping system, and at any low point required to completely drain hydronic-piping system.

F. Provide means for flushing piping system. Provide isolation valve with unions on both sides connecting supply and return lines at top of risers and terminal point of branches serving 2 or more hydronic terminals or equipment connections. Size pipes to achieve velocity of 6 feet per second (FPS) minimum, 12 FPS maximum

G. Select pumps on the ascending side of the efficiency curve. All pumps shall be non-overloading.

H. Engineer shall evaluate system conditions and select the optimum pump type and configuration based on efficiency and pump characteristics.
   1. Recommend in-line circulating pumps or close-coupled end suction pumps for low flow (up to 50 GPM) circulating systems.
   2. Recommend base-mounted end suction pumps for circulating systems with flow rates between 50 and 500 GPM.
   3. Recommend horizontal split case, double-suction pumps for applications with flow rates exceeding 500 GPM.
   4. Vertical in-line pumps shall be avoided but considered for various applications including limited floor space.

I. Provide end suction and split case pumps with Provide suction diffuser and sized to eliminate reducer fitting.

J. Provide pumps design to operate to 1,750 RPM unless directed otherwise.

K. Provide pumps sized for critical speed of at least 115% of operating speed.

L. Provide base-mounted pumps on minimum of 4" high concrete base with inertia pad on vibration isolator.

M. Provide manufacturer's recommended clearances as a minimum. Indicate on Drawings required access space around pumps for service.

N. Provide long radius reducing elbows or eccentric reducers to reduce and minimize turbulence. Provide piping support such that piping weight is not transferred to pump flanges or casing. Provide supports under elbows and suction diffusers attached to inertia bases on pump suction and discharge.

O. Provide a minimum of five straight pipe diameters at pump inlet connections. Provide line size isolation valve on pump suction piping. Provide line sized, spring-loaded silent check valve and isolation valve on pump discharge piping.

P. Provide rigid mounting of base-mounted pumps and vertical in-line pumps above 1 HP with flexible pipe connectors between pump and piping system.

Q. Provide pump gauge panel at all pumps with 3/8” pipe to pump inlet, pump discharge, and upstream of suction diffuser. Each 3/8” pipe shall be provided with an isolation valve.

PART 2 - Products

2.1 Above Ground Piping

A. Pipe Size 2" and Smaller: Black steel pipe; Schedule 40; Class 150 malleable iron fittings with threaded joints.

B. Pipe Size 2-1/2" and Larger: Black steel pipe, Schedule 40, wrought-steel butt-welded fittings with welded joints.

C. Do not use 3” and 5” pipe

2.2 Underground Piping

A. General: Provide a polyurethane pre-insulated underground piping system with HDPE outer shell. The pre-insulated pipe shall be in unitized factory pre-fabricated sections. Pipe shall be listed for use with 44 degrees F. chilled water and 180 degrees F. heating hot water.

B. Core Pipe (4 inches and larger): The core pipe shall be Schedule 40, ASTM A53 ERW black steel rated for 150 psig minimum operating pressure. Pipe ends shall be beveled for welded fittings and connections.

C. Core Pipe (up to and including 2-1/2 inches): ASTM B88 seamless copper, hard drawn or annealed temper, Type K with wrought copper solder joint pressure fittings.

D. Insulation: The insulation shall be formed in place closed cell polyurethane foam providing intimate contact with both the core and casing pipe. It shall be 90-95% close cell with a 2.5 to 6 lb./cu. ft. density. Minimum thickness shall not be less than 1.2 inches for 4 inches and larger and 1 inch for 3 inches and smaller. Fittings and joints on straight runs shall be field insulated with pre- cut polyurethane half-sections of the same thickness as the adjacent pipe, wired in place with all voids being eliminated. Provide perforated flexible heat shrink jacket over joints in the insulation after piping is installed in trench and tested.

E. Casing: The insulation shall be completely encased within a seamless high density polyethylene (HDPE) jacket with a minimum thickness of 125 mils for 3 inches and smaller core pipe and 150 mils for 4 inches and larger core pipe. Jacketing must comply with H-20 Highway loading

specifications. Vapor barrier jacketing material for fittings and joints shall be of the same material and thickness as the pipe jacketing.

F. Joints and Fittings, 4 inches and larger: Fusion Welded fittings.

G. Joints and Fittings, up to and including 2-1/2 inches: Brazed joints in copper piping using Silphos.
1. End Seals: The end of each pipe casing joint shall be sealed to the core pipe with a preformed flexible polyethylene heat shrink end seal to protect the insulation. End seals shall be factory applied and bonded to the jacket and carrier pipe. End seals shall be field applied as per manufacturer's recommendations at pipe cuts. End seals/jacket combinations are to be certified by an independent testing laboratory to maintain a water- tight seal at twenty-foot head pressure for forty-eight-hour test period. End seal certification shall be submitted for approval.
2. Pipe Coating: For additional corrosion protection for the core pipe and fittings, a heavy coat of asphalt mastic shall be applied directly to the exposed portions of all steel pipe and fittings after specified leak testing has been performed and before field insulation kits are installed.

2.3 Piping Specialties

A. Provide a calibrated balancing valve at all connections to equipment with piping connection less than 2". Valve shall have calibrated Vernier adjustment with not less than 4 complete resolutions between open and closed. Handwheel shall incorporate a memory stop. Valve shall have 2 self-sealing PT ports.

B. *Piping connections to equipment greater than 2" shall have a shutoff valve and an electromagnetic insertion type flow measuring device (Onicon FT-3500 or equal) with native BACnet and MODBUS communication protocols via IP (or RS485 to match existing in remodel projects), as well as an analog output for flow and/or energy rate.*

C. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for working pressure of the piping system, with type 304, stainless steel screens.

2.4 Pumps

A. In-Line Pumps
1. Casing: The casing will be ASTM A48 cast iron of the in-line design. The casing shall have tapped and plugged holes for priming and draining. The impeller shall be easily removed without disturbing the casing or suction and discharge piping. The pump casing shall be fitted with a case wear ring to minimize abrasive and corrosive wear to the casing.
2. Impeller: The impeller shall be ASTM B584 bronze, enclosed type, vacuum cast in one piece, keyed to the shaft and fastened with a washer, gasket and cap screw. It shall be finished smooth and cleaned of all burrs, trimmings and irregularities. The impeller shall be hydro-statically and dynamically balanced. Seals: Seals shall be mechanical type. All metal parts

of the mechanical seal shall be stainless steel with "Buna N" elastomers, Ni-Resist seals and carbon washers.

B. Base mounted end suction pump

1. Casing: The casing shall be ASTM A48 cast iron of the end suction design with tangential discharge outlet. The casing shall have tapped and plugged holes for priming and draining. The casing bore shall be large enough to allow removal of the impeller without disturbing the casing or suction and discharge piping. The pump case shall be fitted with a case wear ring to minimize abrasive and corrosive wear to the casing. The case wear ring shall be of the radial type, press fitted into the casing.
2. Impeller: The impeller shall be ASTM B584 bronze, enclosed type, vacuum cast in one piece, keyed to the shaft and fastened with a washer, gasket and cap screw. It shall be finished smooth and cleaned of all burrs, trimmings and irregularities. The impeller shall be hydrostatically and dynamically balanced, and be of a diameter not greater than 85% of the cut-water diameter.
3. Shaft: The shaft shall be Type 316 stainless steel direct-coupled to the power frame shaft. The shaft shall be machined to provide an impeller keyway, and drilled and tapped to accept the impeller fastener. The outboard shaft extension shall be machined with a keyway to accept a coupling to the driving unit. Shaft sleeves shall be Type 316 stainless steel and shall be sealed to the impeller hub by an O-ring, and shall be positively driven by a pin to the keyway. The use of adhesive compounds to fasten the sleeve to the shaft shall not be accepted.
4. Stuffing Box: The stuffing box shall be integrally cast with a mounting bracket, and shall provide an adequate area for internal re-circulation of the pumped fluid around the sealing medium. Each stuffing box shall be furnished with John Crane Type 21 mechanical seals. All metal parts of the seal shall be stainless steel with “Buna-N” elastomers, Ni-Resist seals and carbon washers.

C. Horizontal Split Case Double Suction Centrifugal Pumps

1. Casing: The casing shall be ASTM A48 cast iron of the horizontal split case design. The casing shall have tapped and plugged holes for priming, vent and drain. Removal of the upper half of the casing must allow removal of the rotating element without disconnecting the suction or discharge piping.
2. Impeller: The impeller shall be ASTM B62 bronze, enclosed type, vacuum cast in one piece and keyed to the shaft. The impeller shall be hydraulically and dynamically balanced. The impeller supplied shall be of a diameter not greater than 85 percent of the casing cut water diameter.
3. Shaft: The pump shaft shall be Type 316 stainless steel, one (1) piece, finished and polished on all sections. The shaft shall be of ample strength and rigidity. The maximum allowable deflection of the shaft shall be 0.002 inches at any point of operation on the pump curve.
4. Stuffing Box: A stuffing box shall be provided on each side of the pump casing, designed with sufficient area for incorporation of either packing rings or mechanical seals. Each stuffing box shall be furnished with John Crane Type 21 mechanical seals. All metal parts of the seal shall be stainless steel with "Buna-N" elastomers, Ni-Resist seats and carbon

washers. The stuffing boxes shall be fitted with rings of die-cut, non-asbestos, graphited Teflon fiber packing material. A two-piece gland shall be used to secure the packing and to allow access to the packing without disassembly of unit.

PART 3 - Execution

A. Underground piping installation
   1. Underground piping shall terminate in the building crawl spaces or basement. The underground pipe shall be terminated with a 125# flat face companion flange for interconnection with Schedule 40 pipe. Provide isolation kit for flanges.
   2. Immediately after installation a partial backfill shall be made in the middle of each unit leaving the joints exposed for inspection. After all thrust blocks are poured and cured, a hydrostatic test at 1.5 times the operating pressure shall be performed for a period of four (4) hours.

END OF SECTION 23 20 00

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 31 00 - HVAC DUCTS

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 References

A. SMACNA Standards: Fabricate, support, install, and seal in accordance with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible".

B. ASHRAE Standards: Comply with ASHRAE Fundamentals Handbook and ASHRAE Systems and Equipment for design and fabrication of ductwork.

C. NFPA Compliance: Install duct systems in compliance with NFPA 90A “Installation of Air Conditioning and Venting Systems”.

D. Kitchen Hood Exhaust: Duct systems shall conform to NFPA 96 “Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations”

E. Special Exhaust: Duct systems shall conform to NFPA 91 “Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids”

1.3 Requirements

A. Medium and high-pressure ductwork is hereby defined as ductwork subject to operating pressures in excess of 2” w.g., positive or negative.

B. Low pressure ductwork is hereby defined as ductwork subjected to velocities of 2500 fpm or less, and operating pressure of 2" w.g. or less, positive or negative.

C. Seal ductwork to SMACNA seal Class A. All sealant shall be UL rated with NFPA flame spread of no more than 5 and smoke developed of 0.

D. Balancing dampers
1. Provide balancing dampers at low pressure supply, return, and exhaust branches.
2. Provide balancing dampers on medium pressure return ductwork in mechanical room

3. Provide balancing dampers in medium pressure supply ductwork at floor branch connections in riser system.

E. Provide airflow measuring stations and modulating dampers at return branch serving floor from a riser main to keep floor balanced or slightly pressurized.

F. Ductwork taps shall be conical or clinch collar with 45 degree or boot connections. Connect air devices to low pressure ductwork with five-foot maximum length of flexible duct and provide with a Flex-Flow elbow support. Plenum box may be used in lieu of a Flex-Flow elbow support.

G. Round or oval medium and high pressure distribution supply ductwork is recommended because of lower leakage rates. Provide long-radius elbows (R/D = 1.5) for all round ductwork. Circular ductwork shall be 4" minimum.

H. Provide long-radius elbows (R/D = 1.5) for all rectangular ductwork less than 12" width. Provide long radius elbows on larger ductwork if space permits. Rectangular ductwork shall be 6" minimum.

I. Transition duct sizes gradual, not exceeding 20 degrees divergence and 30 degrees convergence

J. Preferred aspect ratio for ductwork is 1:1 but shall not exceed 2.5:1.

K. Low pressure ductwork shall be sized at maximum velocity of 800 fpm and maximum pressure drop of 0.08" wg/100 ft maximum

L. Medium pressure ductwork shall be sized at maximum velocity of 2500 fpm and maximum pressure drop of 0.25" wg/100 ft maximum.

M. All exposed (visible in space) ductwork in occupied conditioned spaces shall be designed and fabricated from non-perforated, double-wall, flat-oval, or round ductwork. Provide 1 in [25 mm] thick fiberglass insulation between the two walls.

N. Provide flexible duct connection on all rotating equipment.

O. Provide sound attenuators or double-wall ductwork with perforated inner liner as required after the first elbow from both supply and return plenums of the air handling unit(s) to not exceed maximum room noise criteria. Liner shall be 2" thick, tested against erosion to at least 110% of scheduled duct velocity, and treated with an anti-microbial surface coating. Provide bulkhead around ductwork if necessary to avoid breakout noise in occupied spaces.

PART 2 - Products

A. Materials:

1. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lock forming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.
2. Stainless Steel: Stainless steel shall be ASTM A 480 Type 302 or 304 unless noted otherwise
3. Aluminum ducts: ASTM B 209, alloy 3003-H14.
4. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction rated to two (2) inches WG positive and 1.5 inches WG negative for low pressure ducts. Flexible duct shall be wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.

5. Flexible Duct Connectors: UL Listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 ounce per square yard. Provide electrical bonding jumpers across flexible connection.

B. Lab Fume Exhaust: 316L stainless steel with welded seams unless nature of corrosive fumes require otherwise. Travers seams shall be continuously welded and ground. All seams shall be ground/polished smooth. Use 45 degree laterals and 45 degree elbows for branch takeoff connections

C. Kitchen Hood Exhaust: Fabricate in accordance with SMACNA Duct Construction Standards - Metal in accordance with NFPA 96. Construct of 16-gauge carbon steel or 18-gauge stainless steel using continuous external welded joints.

D. Wet air exhaust ductwork: exhaust ducts conveying moist air shall be fabricated of minimum 18 gauge welded stainless steel or aluminum. Use R/D 1.5 radius elbows

E. Volatile fume exhaust ductwork: Sheet Metal and Metal Shapes shall be hot-dipped galvanized steel sheet lock-forming grade conforming to ASTM A 524 and ASTM A 527, having a G90 zinc coating in conformance with ASTM A 90, unless heavier galvanized is specified. Sealants shall be resistant to fumes of acetone, sodium hydroxide, and isopropyl alcohol, and n-Methylpyrrolidone. Gaskets shall be EPR: Ethylene propylene rubber sheet, minimum 1/8 -inch thickness.

PART 3 - Execution

A. Duct Leakage Testing
   1. All supply ductwork upstream of terminal boxes, return ductwork and exhaust ductwork shall be tested for duct leakage in accordance with the latest version of SMACNA HVAC air duct leakage test manual.

END OF SECTION 23 31 00

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 34 00 - HVAC FANS

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 References

A. AMCA 210 and 300: Centrifugal fans must be licensed to bear the AMCA Certified Ratings Seal for both air and sound. Sound rate centrifugal fans in accordance with the latest version of AMCA 300 “Test Code for Sound Rating Air Moving Devices”.

B. AMCA 204: Balance Quality and Vibration Levels for Fans

C. ASHRAE Compliance: Test and rate centrifugal fans in accordance with the latest version ASHRAE 51 (AMCA 210) “Laboratory Methods of Testing Fans for Rating”.

D. UL Compliance: Provide centrifugal fan electrical components which have been listed and labeled by UL.

1.3 Requirements

A. Select each fan to produce 110 percent of capacity required at 120 percent fan static pressure indicated for future renovation allowance.

B. Provide accessories as required:
   1. Access Doors: Provide access door in scroll housing, with latch-type handles, flush mounted for un-insulated housings, and raised-mounted for insulated housings.
   2. Backdraft Dampers: Provide gravity-actuated dampers on fan discharge, counterweighted, with interlocking aluminum blades with felt edges in steel frame
   3. Drain Connections: Provide minimum 3/4 inches threaded coupling drain connection at lowest point of housing.
   4. Extended Grease Lines: Extend grease lines from bearings to outside of inlet duct flange, terminate with grease fitting.
   5. Weather Hoods: Provide protective weather hood with stamped vents over motor and drive compartment.

6. Screens: Provide heavy mesh removable screens on fan inlet and outlet.
7. Fan Guards: Specify guards on inlets and outlets not connected to ductwork, constructed of expanded metal in removable frame

PART 2 - Products

2.1 Centrifugal Fans, Steel (General Application)

A. Provide centrifugal fans built to Class II construction (minimum).

B. Provide factory-assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, and side support structure.

C. Housings: The Housing and frame shall be constructed of aluminum or steel with an enamel finish structurally reinforced to withstand the pressures involved and support the fan and motor. Scroll shall be bolted in place and not welded and capable of being rotated in the field. Provide flanged connections.

D. Wheels: Provide backwardly inclined plate-type blades for sizes 22 inches and smaller, non-power-overloading backwardly inclined airfoil blades for sizes 24 inches and larger. Weld blades to wheel rim and hub plate. The wheels shall be backward inclined. Key wheels to shafts.

2.2 Centrifugal Fans, Fiberglass Reinforced Plastic (Corrosive Applications)

A. Fan Units: Provide factory-assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, and fan support stand. The exterior of the fan housing shall be coated with an industrial grade gel coat, free from surface imperfections, a pigment to achieve the desired color and an inhibitor to prevent ultra-violet degradation.

B. Housings: Construct sections with flange joints utilizing stainless steel bolts and appropriate gasketing. The resins used to fabricate the fan housing shall be premium grade, fire retardant and selected for chemical environment. The fiberglass reinforcement shall be an industrial commercial grade of glass mat or woven roving, such as manufactured by Owens-Corning and shall have a suitable coupling agent to provide a bond between the glass reinforcement and the resin.

C. Wheels: Provide with a cast iron back plate or imbedded hub in the wheel and keyed to a polished steel shaft.

2.3 Power Ventilators

A. Fan Units: Fans shall be belt or direct driven as scheduled. Direct drive units shall have speed controls mounted on the fan housing. Provide upblast fans where possible

B. Housing: Ventilator housing shall be of heavy gauge spun aluminum construction and shall be weatherproof, incorporating an integral weather shield

C. Wheels: Fan wheels shall be statically and dynamically balanced and shall have a spun venturi inlet. The fan shall be keyed to solid carbon steel shaft and mounted in self aligning pillow block ball bearings

D. Kitchen: Exhaust fans shall be upblast type and be UL 762 listed.

2.4 Utility Fans

A. Fan Units: Provide factory-assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, and fan drive.

B. Housings: Construct of heavy-gage steel with side sheets fastened to scroll sheets by means of deep lock seam. Provide round inlet collar, slip joint discharge duct connection. Construct housings to be convertible to 8 standard discharges. Provide adjustable motor supports.

C. Wheels: Provide forward curved or backward inclined wheels as scheduled. Provide swaged hubs.

2.5 Tubular Centrifugal Fans

A. Fan Units: Provide factory-assembled and tested fan units consisting of housing, wheel, fan shaft, bearings, straightening vanes, and motor support. Clean, condition, and prime paint sheet metal parts prior to final assembly. Apply final coat of enamel to exterior surfaces after assembly.

B. Housings: Construct housings of low carbon steel with continuous-weld construction, braced to prevent vibration or pulsation. Provide streamlined inlet and outlet configurations.

C. Wheels: Provide airfoil type blades and welded construction. Statically and dynamically balance wheels before assembly, and balance again in assembled unit at design rpm.

2.6 Inline Centrifugal Fans

A. Housing: Casing shall be fabricated of heavy gauge spun aluminum and shall have a hinged panel to allow service of the fan and drive assembly without dismantling the fan. Fan housing shall be internally lined with one (1) inch thick neoprene coated fiberglass insulation. Steel housings shall be epoxy coated. Housing shall have collars for duct connections.

B. Belt-Drive Units: Request ball bearing motor mounted on adjustable base out of air stream. Provide enclosure around belts. Provide lubricating tubes from fan bearings to outside of fan housing.

C. Wheel: Aluminum airfoil blades on aluminum hub.

2.7 Vane Axial Fans

A. Housing: Steel with welded construction or corrosion resistant fasteners

B. Propeller: Shall be adjustable pitch with cast aluminum blade

C. Fan Units: Provide factory assembled and tested fan units consisting of housing, propeller and hub, fan shaft, bearings, and fan drive.

D. Provide access doors before and after fan.

END OF SECTION 23 34 00

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 References:

A. ARI 880 - Terminal Unit Test Code.

B. ARI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

C. ARI 410 - Forced-Circulations air cooling and air heating coils

1.3 Requirements

A. Following terminal units shall be considered for room HVAC
   1. Series fan powered boxes with variable frequency motor controllers
   2. Single duct variable air volume systems
   3. Double duct terminal boxes if used in surrounding existing construction

B. Rooms that are thermally and functionally similar may be grouped together. A maximum of 3 rooms may be placed on one thermostat

C. Provide pressure independent terminal boxes. Units shall be capable of controlling air volume to within plus or minus 5% of air volume setpoint, as determined by the zone temperature sensor demand with variations in inlet pressures from 0.10” to 6” w.g.

D. No sound rating for any air terminal device shall exceed the NC levels under the design operating conditions, the duct and diffuser layouts as shown on the Drawings, and assuming room losses no greater than 7 dB up to 180 square feet (sf), 8 dB up to 250 sf, or 10 dB for rooms greater than 250 sf

E. Unit sound power levels shall be selected at 1.5 inches static pressure to meet noise criteria levels at maximum scheduled airflow.

F. Provide attenuators as required to meet noise criteria. The attenuator shall be fabricated as a separate section and field installed at the discharge of the terminal unit.

G. Reheat coils shall be designed for 140°F water temperature. Coils shall be selected for the largest water temperature difference possible with a maximum pressure drop across the coil of 2 feet water gage. Maximum leaving air temperature to the room shall be 95 degrees F. A calibrated balancing valve shall be provided at all reheat coils. Schedule shall include:
1. Box minimum airflow volume
2. Coil entering and leaving air temperatures
3. Number of coil rows

H. Provide single point power connection.

I. Provide enclosure for terminal unit controls which includes an external metalclad 2 pole, 15 amp, 120 volt disconnect switch. Dimensions of enclosure shall include room for control board, transformer, online/offline communication switch, I/O terminal strip, and damper operator.

PART 2 - Products

2.1 Single duct terminal boxes

A. Units shall be constructed with minimum 22 gauge galvanized steel enclosures. Provide minimum 3/4" internal lining with all edges sealed against airflow erosion in accordance with NFPA 90A and UL 181.

B. Leakage:
1. Damper Leakage: Damper leakage at shutoff shall not exceed 2% of terminal unit's scheduled maximum inlet rated airflow at 3 inch W.G. rated inlet static pressure.
2. Casing Leakage: Casing leakage shall not exceed 2% of terminal unit's maximum rated capacity at 0.5 inch W.G. inlet static pressure.

C. Primary Air Valve:
1. The primary air valve shall be of a design that shall vary primary air supply in response to an electronic signal.
2. Construction:
   a. Body, 22 gauge galvanized steel
   b. Damper Blade, 18 gauge galvanized steel or aluminum, riveted or bolted through a solid shaft , bronze oilite self-lubricating bearings.
   c. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges.
   d. Damper assembly shall be fully removable.
3. Valve assembly shall include internal mechanical stops for both full open and full closed positions

D. Sound Attenuation: The attenuator shall be fabricated as a separate section and field installed at the discharge of the terminal unit.

E. Maximum pressure drop across terminal unit, including hydronic heating coil, shall not exceed 0.4" w.g. at maximum flow.

2.2 Series Flow Fan Powered Terminal Units

A. Units shall be constructed with minimum 20 gauge galvanized steel enclosures. Provide minimum 3/4" internal lining with all edges sealed against airflow erosion in accordance with NFPA 90A and UL 181.

B. Leakage:
1. Damper Leakage: Damper leakage at shutoff shall not exceed 2% of terminal unit's scheduled maximum inlet rated airflow at 3 inch W.G. rated inlet static pressure.
2. Casing Leakage: Casing leakage shall not exceed 2% of terminal unit's maximum rated capacity at 0.5 inch W.G. inlet static pressure.

C. Primary Air Valve:
1. The primary air valve shall be of a design that shall vary primary air supply in response to an electronic signal.
2. Construction:
   a. Body, 22 gauge galvanized steel
   b. Damper Blade, 18 gauge galvanized steel or aluminum, riveted or bolted through a solid shaft , bronze oilite self-lubricating bearings.
   c. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges.
   d. Damper assembly shall be fully removable.
3. Valve assembly shall include internal mechanical stops for both full open and full closed positions

D. Fan Assembly:
1. Fan: Forward curved centrifugal type with dynamically balanced wheel with a direct drive motor. The primary air supply system is designed to provide at least 0.5 inch W.G. static pressure at the inlet to the terminal device.
2. Motors shall be ECM type.

E. Sound Attenuation: The attenuator shall be fabricated as a separate section and field installed at the discharge of the terminal unit.

2.3 Terminal Heating Coils:

A. Shall be hot water fin and tube type constructed of seamless copper with aluminum fins mechanically bonded to the tubes and copper headers.

B. Casing and tube supports shall be minimum 16 gauge galvanized steel.

C. Coils shall be drainable, suitable for 250 psig working pressure, with circulated tubes factory tested at not less than 300 psig air pressure.

2.4 Dual Duct Terminal Units

A. Units shall be constructed with minimum 22 gauge galvanized steel enclosures. Provide minimum 3/4" internal lining with all edges sealed against airflow erosion in accordance with NFPA 90A and UL 181.

B. Leakage:

1. Damper Leakage: Damper leakage at shutoff shall not exceed 2% of terminal unit's scheduled maximum inlet rated airflow at 3 inch W.G. rated inlet static pressure.
2. Casing Leakage: Casing leakage shall not exceed 2% of terminal unit's maximum rated capacity at 0.5 inch W.G. inlet static pressure.

C. Primary Air Valve:

3. The primary air valve shall be of a design that shall vary primary air supply in response to an electronic signal.
4. Construction:
   a. Body, 22 gauge galvanized steel
   b. Damper Blade, 18 gauge galvanized steel or aluminum, riveted or bolted through a solid shaft , bronze oilite self-lubricating bearings.
   c. The dampers shall seat against gasketed stops or the dampers shall have gasketed edges.
   d. Damper assembly shall be fully removable.
   e. Valve assembly shall include internal mechanical stops for both full open and full closed positions
5. Sound Attenuation: The attenuator shall be fabricated as a separate section and field installed at the discharge of the terminal unit.

PART 3 - Execution

1.1 Installation:

1. Primary air connections to VAV terminals must always be made with a rigid duct of 6-8 duct diameters to avoid high turbulence in proximity of VAV terminal flow sensor. Reducer and

increaser duct fittings shall not be installed immediately upstream of the VAV terminal duct connection collar. Flexible duct connection shall be limited to 12 inches.

2. Ensure sufficient area is provided next to fan, controls, and reheat coil valves for maintenance and as required by code and manufacturers recommendations.
3. All terminal units shall be installed above aisle ways or similarly accessible locations. No installation in offices, above desks, or in conference rooms.

END OF SECTION 23 36 00

Division 23 – Heating, Ventilating, and Air–Conditioning (HVAC)

SECTION 23 73 00 - CENTRAL STATION AIR HANDLING UNIT

PART 1 - General

1.1 Purpose

A. These documents are provided to establish a basis of design and ensure quality and consistency in the design of mechanical systems which satisfy the functional and operational requirements of ACCD. Deviations from these guidelines must be justified through LCC analysis and submitted to ACCD for approval.

1.2 References:

A. ARI 410 - Forced-Circulations air cooling and air heating coils

B. ARI 430 - Central station air handling units

C. AMCA 99 - Standards Handbook

D. NFPA 90A - Standard for the installation of air conditioning and ventilating systems

1.3 Requirements

A. Test and rate chilled water, hot water and steam coils in accordance with ARI 410. Display certification symbol on units of certified models.

B. Do not operate air handling systems for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation of representative.

C. Air Handler fabrication shall conform to AMCA 99 and ARI 30 in the absence of direction in this standard.

D. Provide air handling unit internal insulation having maximum flame spread rating of 25 and maximum smoke developed rating of 50.

E. Provide air handler casings design, manufactured, and installed such that no condensation shall form on the exterior or interior surfaces (other than on cooling surfaces), including joints and seams.

F. It is preferable to have the supply fan in a draw-thru configuration. Chilled water coil should be selected to maintain maximum 60% room relative humidity conditions. Provision in controls must

be made to keep fans from remaining wet for long periods. Preferred control loop is to close chilled water valve at the end of each day and allow the discharge air temperature to reach inlet air dewpoint plus 4-5 degrees. A second option is to run fans for 15 – 30 minutes after occupation time is complete and the chilled water valve is closed off.

G. Provide damper at air handling unit supply, return, return to system, relief and outdoor air dampers. Dampers shall have end switches.

H. Provide direct or indirect method to determine outside air quantity. If outside air is measured directly, a MERV 8 filter shall be placed upstream of airflow measuring station with a maximum face velocity of 450 fpm.

I. Provide minimum of three airflow measuring stations at each unit - supply, return, and additional for direct or indirect measurement of outdoor air.

PART 2 - Products

2.1 Air handler Casings

A. General: Provide horizontal or vertical type factory-fabricated air handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

B. Construction: Each unit shall have a double wall airtight and weatherproof casing and shall be sectionalized for placement (indoors or outdoors) for all internal components. Provide stainless steel inner liner for all ahu sections. For units located in un-air-conditioned rooms, provide a welded, full perimeter structural or tubular steel base frame with intermediate supports for all internal components. Provide thermal break construction between exterior panel and frame. Unit casings shall be insulated internally to provide minimum R-13 thermal resistance. Provide double bottom floor construction minimum R-13 thermal resistance and full walk-on interior non-skid surface.

C. Performance: Unit casing shall be constructed, assembled, and factory tested to withstand operating pressure of 1.5 times the operating pressure or 6 inches w.g. positive (whichever is greater) with a maximum leakage rate of 1% of total airflow and deflection of 1/200th of the panel width or height.

D. Coil Section: The coil section shall completely enclose the coil headers and return bends. Coil frames shall not be used as structural members of the coil section. The coil section shall be constructed in such a manner that the coils can be removed without affecting the structural integrity of the casing.

E. Condensate Drain Pan: Drain pans shall be full width and extend completely under the coil section. Unit shall drain all water from the drain pan within 5 minutes after the unit has

shutdown. The unit shall have a minimum 1-1/2 inch threaded drain connection. The drain pan shall be insulated, double wall type constructed of 304 stainless steel inner pan with stainless steel drain nipples and a galvanized, or painted, outer pan. Provide drain pans with rigid glass finer insulation and type 316 stainless steel inner pan. The drain pan shall extend under the complete cooling coil. Drain pans shall not recess into floor of casing. Provide intermediate drain pans for stacked coil banks.

F. Access: Provide double wall insulated walk-in access doors with full perimeter gaskets in each casing section. Provide doors with windows, continuous stainless steel hinges, and quick opening handle with locking latch. Access doors shall be 6 feet in height and have a clear opening that accommodates the removal of the largest replacement component, i.e. fan motor, but in no instance shall be less than 18 inches wide. Access doors shall have enclosed fluorescent lighting switched from the access door.

G. Electrical and Lighting
1. Vapor-proof light using cast aluminum base style with glass globe and cast aluminum guard shall be installed in each access section. The lights in each compartment shall be controlled by a switch with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system.
2. Install compatible 22 W twin tube fluorescent lamp in each light fixture
3. Provide convenience duplex outlet next to the light switch

H. Filter Gauges:
1. Provide surface mounted magnahelic gauge for each prefilter and final filter bank, with integral leveling screw and graduated to read appropriate pressure range based on maximum dirty filter pressure loss.
2. Provide pressure tips, tubing, gauge connections, and mounting bracket.

2.2 Chilled Water Coils

A. Chilled water coils shall have same-end supply and return connections unless otherwise indicated.
1. Coils shall be constructed of seamless, hard-drawn copper tubes 5/8 inches O.D. with 0.035 inches thick minimum wall thickness.
2. Continuous, flat, unenhanced plate type aluminum fins permanently bonded to the tubes by mechanical expansion of the tubes. Coil assemblies shall be maximum 8 rows deep. Coils shall have maximum 10 fins per inch. Fins shall be 0.010 inches thick copper.
3. Water coils shall be circuited for complete drainability.
4. Internal tube baffles or turbulators are not acceptable.
5. Internal tube grooves or riflings are not acceptable.
6. Stacked coils shall be independently demountable and supported on internal racks.
7. Face velocity shall be maximum 450 f.p.m at unit design airflow.

B. Coil headers shall be of heavy gauge seamless hard drawn copper tubing.

C. Coil connections or nozzles shall be of the same diameter, or larger, as the coil headers

D. Each coil assembly shall have factory installed drain and vent connections.

E. Select coils for maximum coil pressure drop of 12 feet w.g. with a minimum chilled water temperature difference of 14 degrees F

2.3 Hot Water Coils

A. Hot water coils shall be constructed the same as chilled water coils except they shall be two row and shall use a minimum 16 gage galvanized material for casing construction. Fins shall be 0.010 inches thick minimum.

B. Face velocity to be no greater than 450 f.p.m.

C. Preheat coils shall be piped to provide constant flow, variable temperature with a three way valve and in-line pump.

2.4 Fan Section

A. Fan sections shall have perforated 20 gauge galvanized steel liner with mylar encasement over the fiberglass insulation. Perforated liner shall be on walls and roof. Floor liner shall be solid

B. Provide fan walls. Fans shall be plenum fan with an aluminum airfoil backward curved wheel keyed to a solid steel shaft. Each plenum fan shall have a motorized damper. Provide means of controlling each fan's speed thru variable speed motor controllers or Electro-Commuted motors (ECM)

2.5 Filters

A. Only filter sizes 24" x 24" and 24" x 12" are acceptable.

B. Air handling unit shall be selected to avoid blank off plates.

C. Provide flat filter sections with hinged access doors on each end of the section. Furnish 2" minimum thickness, dry type, MERV 8 disposable filters with 100% synthetic media. Fan shall be selected for initial filter pressure drop plus 0.4" for dirty filter allowance.

D. MERV 13 filters, if required, shall be 12" deep. Fan shall be selected for initial filter pressure drop plus 0.6" for dirty filter allowance.

E. Provide schedule indicating number of filters, filter sizes, initial pressure drop and final pressure drop for each air handling unit.

PART 3 - Execution

3.1 Installation:

A. Mount units on concrete housekeeping pads. Housekeeping pad shall be 4" overall longer and wider than equipment supported

B. Provide structural steel rail full length of air handling unit to achieve 10" clearance from floor to base of unit to achieve a condensate drain trap seal depth of 6" with minimum 3" from bottom of condensate drain pipe from unit to top of the trap weir.

3.2 Leak and Pressure Testing:

A. After installation, air leakage test and air pressure test.

B. Unit casing shall be tested to withstand operating pressure of 1.5 times the operating pressure or 6 inches w.g. positive (whichever is greater) with a maximum leakage rate of 1% of total airflow and deflection of 1/200th of the panel width or height.

END OF SECTION 23 73 00

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SECTION 26 00 01 – GENERAL DESIGN CRITERIA

PART 1 - General Introduction

1.1 General Introduction

A. The Electrical Design Guidelines and Guide Specifications, as prepared by the Coordinating Engineer, are intended to establish standards, policies, and practices for electrical design for the Alamo Community College District. They should be used as a guide only and are not intended to cover every situation or to restrict innovative design. Where good design dictates a deviation from the design standards, the Design Engineer should submit in writing a Request for Verification (RFV) to the Project Manager.

B. The Guideline Specifications shall be edited by the Design Engineer to conform to each project.

C. The Standard Guideline Details may be used directly as part of the Contract Documents. They should be revised as required to suit the construction conditions for each particular project. All construction details, schedules, and legends shall be shown on the Drawings only and not printed as part of the Project Specifications.

D. The Design Engineer should not assume Alamo Community College District, the Project Manager, or the Campus Coordinating Engineer will provide for or perform any services without specific prior agreement.

PART 2 - General Design Criteria

2.1 Codes and Ordinances

A. All design, materials, installation, fabrication, testing, etc. shall comply with the applicable rules of the latest published National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by the National Fire Protection Association), the City Electrical Codes and Ordinances, and the terms and conditions of services of the Electrical Utility, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. Where duplication of requirements occurs between codes, the more stringent requirement will be followed. None of the terms or provisions of these Electrical Design Guidelines shall be construed as waiving any of the rules, regulations or requirements of these authorities.

2.2 General Requirements for All Electrical Equipment (Main service, panels, generators, transformers, etc.)

A. Location

1. The main distribution equipment shall be designed to:
   a. Be located in a separate room as near as possible to the entrance of the main service feeders into the building.
   b. Minimize the length and cost of main feeder and secondary conductor lengths.
   c. Minimize the number of new panels and transformers.
2. The space allowed for all electrical equipment should be able to accommodate the standard sizes of equipment of at least three different manufacturers.
3. The location, size, and weight of all electrical equipment shall be coordinated with the mechanical, architectural, and structural Drawings. This is required for all engine-generator sets and their controls, main switchboards, motor control centers, main panelboards rated above 600 amperes, switches and circuit breakers mounted separately from panelboards and rated above 600 amperes, automatic transfer switches, and dry type transformers.
4. The electrical system shall be designed in conjunction with mechanical equipment to allow the desired or required control of equipment. An example would be to feed all classroom units on a common control switching zone from a common panel.
5. Low voltage electrical distribution equipment shall be located as close as possible to the center of load to minimize voltage drop.
6. Dimming systems, lighting control panels, and other gear with temperature sensitive electronics shall be located in conditioned spaces.

B. Access - All equipment shall be located so as to be accessible for installation, operation, and repair. Electrical spaces shall be of suitable size to permit inspection and maintenance and to provide space for future equipment when required. Adequate space shall be furnished for maintenance as indicated in clearances below.

C. Noise - The Design Engineer should take into consideration the effect that equipment noise or vibration might have on areas adjacent to, above, or below the equipment.

D. Ventilation - All rooms which contain heat producing electrical or electronic equipment shall be ventilated or air conditioned as required by equipment manufacturer. Maximum temperature should be 30 degrees C.

E. Clearance – The National Electrical Code (NEC) requires that space be dedicated for electrical equipment such as panelboards, switchboards, etc. Application rules for this code will be as follows:

1. The working space required shall be maintained about all electrical equipment. This space shall be dedicated from floor to structure.
2. Dedicated shall mean that no foreign material such as pipes, ducts, boxes, etc. shall be located in this space.

3. Any piping required for fire protection (sprinkler piping) shall not be considered as foreign and will be allowed. Good design would dictate that sprinkler piping or any pipe or duct conveying liquids not be located directly over electrical equipment.
4. Electrical equipment may be located in rooms with other items, such as mechanical equipment, as long as these items do not infringe upon the space dedicated for the electrical equipment or conflict with requirements of the Uniform Mechanical Code.

F. Enclosure Rating - NEMA Standard Publications covers the classification and description of enclosures for electrical equipment rated 1,000 volts or less. These standards are used by the electrical industry to provide guidelines for the manufacture and application of these enclosures. The standards shall be followed when designing or specifying electrical equipment rated 1,000 volts or less in non-hazardous or hazardous locations. The NEMA enclosure type shall be specified by the Design Engineer and be as required by the environment. In general:
1. NEMA 1 enclosures shall be used indoors in general locations not subject to getting wet.
2. NEMA 3R enclosures shall be specified and indicated for outdoor locations and indoor damp locations where the equipment is not subject to driving rain or hose down.
3. NEMA 4X enclosures shall be provided indoors where subject to hose down or very wet conditions or corrosive conditions and outdoors where susceptible to driving rain.

G. Maintenance Considerations - It is essential to the present and future operation of all facilities that during the design stage proper consideration be given to maintenance. The Design Engineer shall consider the following items to provide for access and ease of maintenance. The list is not intended to be comprehensive and the Design Engineer shall consider other items not listed below.
1. Switchgear shall be in separate rooms. Adequate space shall be provided around and above switchgear for installation of conduit. Piping and ductwork are not allowed directly over switchgear or in the working space allocated for the switchgear.
2. Equipment room shall be large enough to provide access to all equipment and for removal and replacement of equipment.
3. Equipment room doors should be sized to accommodate all maintenance operations for equipment installed in a room, including removal and installation of the equipment.
4. Provide nominal 4" high concrete housekeeping pads under all floor mounted equipment. This applies also to all panelboards that extend from the floor.
5. Consideration should be made when selecting equipment in order to minimize the need for specialized services for maintenance and repair.
6. Proper space and accessibility shall be provided around all electrical equipment so as to allow maintenance without difficulty or excessive costs.
7. Adequate lighting, emergency lighting, and general power shall be provided around all electrical and mechanical equipment for maintenance. (See HVAC)
8. All lighting design shall consider lighting maintenance in its entirety. Such items as susceptibility to dirt collection, ease of cleaning, ease of replacing, and durability should be considered when selecting fixtures.
9. Roof penetrations are not allowed without the Project Manager's permission.

H. Wiring and Conduit Callouts

1. To maintain a standard method of identifying conduits and the conductors within, the following protocol shall be utilized:
   a. Conduit size and quantity shall be shown first. The conventional conduit trade size shall be indicated in inches.
   b. Next, the quantity and size of conductors shall be shown.
   c. And last, the ground conductor size shall be given.
   d. Conductor sizes "0" through "0000" shall be indicated as "1/0", "2/0", "3/0", and "4/0".
   e. Conductor sizes beginning with 250 shall have "kCMIL" included as part of the callout, i.e., "250 kCMIL".
   f. Example: 2" C. - 4 #2/0 and 1 #6 GND indicates a 2" conduit with 4 #2/0 conductors and 1 #6 ground.
   g. Example: 2-3" C. Ea. W/4-250 kCMIL and 1 #2 GND indicates two parallel 3" conduits each with 4-250 kCMIL conductors and 1 #2 ground.

I. Future Provisions

1. A minimum of 20% spare capacity for future load expansion shall be furnished throughout the electrical system.
2. This spare capacity applies to spare ampacity in switchboards, panelboards, motor control centers, transformers, lighting control systems, etc., as well as spare devices in panelboards and spaces in switchboards, motor control centers, etc. For switchboards and motor control centers, this can be met by providing floor space and provisions for future sections.
3. Where this spare capacity is difficult or very expensive due to existing services or conditions, the Design Engineer should inform the Project Manager and include his recommendations with cost estimates.
4. Furnish at least 25% spare or a minimum of one spare conduit at each electrical service entrance equal to the service entrance conduit(s) size. The spare conduit should be stubbed out of the building 5'-0" (past walkways where applicable) and capped off for future use. Spare conduits shall be stubbed out of buildings as provision for future extension of power.

J. Voltage Recommendations

1. Contact the Project Manager for service transformer locations and voltages available at all new facilities.
2. Existing facilities shall utilize existing service voltage with the following exception:
   a. 120/240 volt, 3 phase, 4 wire panels shall be used only to retrofit existing installations having this voltage class. In this case, the panel shall be specifically manufactured and rated for the application (i.e., two separated sections shall be provided, one for 1 and 2 pole breakers and one for 3 pole breakers only). When practical, two separate panels should be provided as outlined above.
   b. Where practical, buildings with 120/240 volt, 3 phase, 4 wire service should be converted to 120/208 volt, 3 phase, 4 wire.

K. Building/Utility System Interface - The Design Engineer shall indicate the electrical system interface between the building and the campus utility systems on the Construction Documents.
   1. Power - Service raceways and conductors shall be extended from the building to the primary transformer and terminated.
   2. Special Systems - Raceways for communications and special systems shall be extended to the communications manhole or 5' outside the building as designated by the Project Manager. Conductors shall be extended to the appropriate campus interface point for the central equipment, if required.

L. Coordination of Design
   1. The Design Engineer shall coordinate his design with all other disciplines (architectural, civil, structural, mechanical, etc.) including:
      a. Coordinate all special types of equipment for correct rough-in requirements.
      b. Coordinate all ceiling and wall furring to conceal new conduit, etc.
      c. Patching and painting shall match existing adjacent areas (floors, walls, ceiling, etc.) where removals, remodeling, or restoration occurs.
      d. Coordinate construction of any new mechanical and electrical equipment rooms.
      e. Coordinate the installation of proper sized doors for equipment removal.
      f. When ceiling plenums are utilized for return air, coordinate that no non-plenum rated cables exist in the same space. Cables shall be installed in cable tray or conduit.
      g. All raceways shall be concealed in finished areas, if feasible. Where raceway must be exposed, it shall be Wiremold or equal and be indicated on the plans. Exposed conduit in finished areas will not be allowed without the Project Manager's permission.
   2. A light table check shall be performed to determine if any conflicts exist. This check will be used to verify the following:
      a. All mechanical equipment requiring electrical service has been shown and provided power.
      b. Light fixture locations do not conflict with air diffusers, sprinkler heads, ceiling grilles, speakers, etc. They should also match the reflected ceiling plan and grid. Ceiling grid type and fixture compatibility should be verified.
      c. Clearances above fixtures, especially LED downlights, should be checked with the structure, ductwork, piping, etc.
      d. Switchgear locations should be compared with structure to coordinate conduit entry and exit. Any piping in the room should not be routed over switchgear.
      e. Panelboard locations should be checked for wall depth and fire rating. Installation of panels in rated walls should be coordinated with the authority having jurisdiction.

M. Receptacle Coverplates: Coverplates for power and switch outlets shall be stainless steel Type 430, unless otherwise specified.

END OF SECTION 26 00 01

SECTION 26 00 02 – DESIGN FOR EXISTING BUILDINGS

PART 1 - Design for Existing Buildings

1.1 Site Surveys and Documentation

A. The Design Engineer shall visit the site and familiarize himself with all existing conditions, systems, dimensions, details, etc. which will affect his project(s). They shall make themselves aware of the current function of existing buildings and any changes or intended new use of the building. New buildings will not require as much field verification as existing buildings which are being renovated or added to, but the site must still be surveyed. Each survey shall also include an investigation of existing facilities (infrastructure, other buildings, etc.) to be affected by the new construction. The Design Engineer should coordinate and schedule all site visits/surveys with the Project Manager.

B. The following items shall be considered during investigation of existing facilities which are scheduled for renovation. The Design Engineer shall recommend replacement or reconditioning of existing equipment where warranted and provide estimated costs where required.
   1. Age and condition of existing equipment.
   2. Maintenance cost and availability of parts for the existing equipment.
   3. Economy of distributing power at the existing system voltage.
   4. Short circuit withstand and interrupting ratings (including bus bracing) for all existing equipment.
   5. Safety and correct application of existing systems.
   6. Reliability of existing electrical systems.
   7. Present loading of electrical equipment.

C. General Electrical Demolition Considerations: Following are some general electrical demolition items to be considered by the Design Engineer:
   1. Equipment not indicated or not indicated to be removed should remain in service except:
      a. Equipment in walls and partitions being removed should be removed.
      b. Facilities which interfere with the installation of new partitions should be relocated as required to accommodate the new partitioning.
      c. Outlets serving facilities or equipment being removed should be removed or abandoned.
      d. Where wiring serving facilities to remain passes through removed outlets, reuse outlet in place as a junction box or relocate wiring as required. Route all conduit and conductors concealed in building construction.
   2. Where partition removal exposes facilities to remain or services to facilities which remain, relocate facilities or services as acceptable to the Owner's representative.
   3. The Contractor shall relocate any and all outlet boxes, conduit, and conductors as required to clear openings cut through walls, floors, ceilings, and roofs for construction modifications, and for installation of equipment by other trades, route all conduit and conductors concealed where possible. All floor, wall, and structural penetrations in existing

construction shall be drilled not closer than 12" from any column or 6" from soffit of beams or as approved by the Owner's representative.

4. Where conduit and conductors are indicated to be removed, conduit shall be removed to point of concealment and wiring removed entirely. Provide blank cover plates where required.
5. Reference the mechanical or plumbing demolition plans for additional equipment being removed or abandoned.
6. Where the installation of new air conditioning equipment interferes with existing electrical outlets, the existing outlets should be relocated to be clear of new air conditioning equipment.
7. All salvage will remain the property of the Owner and shall be delivered by the Contractor to a location as directed. Any salvage not desired by the Owner shall become the property of the Contractor and shall be removed from the premises.

END OF SECTION 26 00 02

SECTION 26 00 03 – NORMAL POWER DISTRIBUTION SYSTEM REQUIREMENTS

PART 1 - Normal Power Distribution System Requirements

1.1 Schematic Design Load Analysis Criteria

A. A preliminary load analysis must be done during Schematic Design.
   1. The Design Engineer will contact the Project Manager for available voltage.
   2. Equipment space requirements will also be determined based on the preliminary load analysis. Transformers, if required, can be located. Space and clearances for panels, switchboards, motor control centers, etc. can be allocated.

B. Preliminary load estimates will be made based on actual loads for the different electrical load groups or on the "volt-amperes per square foot method". The electrical load groups to be included in the preliminary load analysis are:
   1. Lighting - Lighting loads will be estimated using the latest edition of the NEC and I.E.C.C. An I.E.C.C. Lighting Compliance Certificate shall be submitted with each project. In addition to IECC, documentation satisfying local AHJ's (i.e. IB221 per City of San Antonio) shall also be submitted with each project.
   2. General Power - General purpose receptacle outlet loads may be estimated at between 1.0 and 2.0 volt-ampere per square foot depending on the project. The Design Engineer shall consider future use of personal computers in educational facilities.
   3. Building Power Loads - Building power loads (ventilating systems, miscellaneous loads, air handling units, etc.) may be estimated on a volt-ampere per square foot basis depending on the project.
   4. Air Conditioning - Air conditioning (A/C) loads depend on the type of building, locality, construction, orientation, internal heat gain, size, and type of equipment. The preliminary A/C electrical power load should be actual loads or should be estimated on a volt-ampere per square foot based on the type of building and system to be used.
   5. Kitchens - Electrical cooking loads shall also be included and shall be coordinated with the kitchen consultant.
   6. Special Loads - Special loads, such as elevators, main frame computers, etc. shall be included as applicable.
   7. Future - Future loads shall also be considered and sufficient reserve capacity (20%) shall be provided.

1.2 Construction Documents Electrical Design Criteria

A. Main Service Entrance
   1. Service Selection - Selection of service characteristics shall be based on an economic analysis.
   2. Service Characteristics

a. Secondary Services
   1) Sources - Secondary service voltage shall be determined from the distribution transformers provided to service the individual project. Consult the Project Manager for voltage.
   2) Three Phase Wye - Either 208Y/120-volt or 480Y/277-volt, three phase, 4-wire service shall be provided.
   3) Service Equipment - Locate service entrance equipment as near as possible to the building service entrance point. Circuit breakers or fused disconnects shall be used as indicated under Overcurrent Protection.
   4) The Design Engineer shall coordinate the service entrance equipment with the infrastructure design to avoid redundant protection and minimize cost.

3. Short Circuit Considerations - Devices must be able to clear any fault which may occur on the secondary systems without damage.
4. Service Equipment Rooms - Utilities shall be accessible and equipment rooms shall be sized to provide sufficient space for maintenance. If electrical equipment is located in an electrical-mechanical equipment room, adequate space for electrical equipment shall be reserved. Temperature sensitive equipment shall not be located in mechanical / electrical rooms that are not conditioned.
5. Service Grounding - See section on grounding.
6. Service Feeders
   a. Number - The number and arrangement of incoming feeders shall be based on requirements for maximum uninterrupted service, large motor inrush characteristics, and the reliability of the distribution system.
   b. Capacities - Each service feeder shall be based on the sum of distribution feeder load requirements, future loads, and system demand factors. However, it shall not be less than the capacity calculated from the values based on the latest National Electrical Code. Neutrals of secondary services shall be full size, where required, to carry electrical discharge lighting, data processing, or similar equipment loads where harmonic currents are present.
7. Service Feeder Conduits
   a. Conduits for service feeders shall be run underground from the point of connection of the pad mounted transformer to the exterior wall of the room or vault in which main service disconnecting equipment is located.
   b. Secondary service conduits shall be steel or rigid PVC with concrete envelopes. A minimum of one spare conduit shall be provided for each underground service. Four inch minimum diameter service conduits shall be used, except 2" minimum will be allowed for services 100A or less.
8. Service Disconnecting Equipment
   a. Secondary Disconnecting Equipment - Service disconnecting devices shall be molded case circuit breakers or fused-load break switches of the quick-break type.
   b. Ratings - Continuous current ratings of service disconnecting devices shall be calculated on the same basis as the capacities of the feeders they serve.
9. Ground Fault Protection

a. Application - Ground fault protection (GFP) shall be applied as required by the National Electrical Code. To achieve selectivity and continuity of service, additional GFP may be required on feeder and branch circuits.

b. Selection - Economics shall be weighed against the cost of outages and potential cost of equipment damage to arrive at a practical system. Each system shall be analyzed individually. The following factors shall be considered in selecting GFP:
   1) Type of power distribution
   2) Reliability required
   3) Neutral circuit complexity
   4) Number of ground return paths
   5) Rating and application of protective devices
   6) Setting of protective devices
   7) Service Metering: A pulse type kilowatt hour demand metering is required at each building service with provision for connection to the EMCS system.

B. Main Switchboards and Motor Control Centers

1. Switchboards and motor control centers shall include as a minimum the same information as for panelboards. A one-line type format shall be used for switchboards in lieu of the standard panel format. A schedule may be used for motor control centers. In addition, the following shall also be provided when applicable:
   a. Short circuit bracing
   b. Phase, neutral, and ground bus current rating
   c. NEMA wiring type
   d. Individual starter information (e.g., NEMA size, type, etc.)
   e. Special features
   f. Elevation of equipment with overall dimensions
2. General Requirements - A main low-voltage switchgear assembly shall be provided for each building that requires secondary service rated more than 600 amperes. Switchboard shall be enclosed, dead-front type. Secondary service disconnecting devices and metering equipment, where required, shall be included in main switchgear assemblies. Each switchgear assembly shall include a circuit breaker or fused switch for each outgoing feeder. Number of service disconnects shall be limited to six as per latest National Electrical Code. A voltmeter and ammeter with switches shall be provided. A KWH meter with demand register and pulse initiator for interface with the EMCS shall be provided.
3. Expansion - Each low-voltage switchgear assembly shall be designed with main bus spare ampacity and appropriate spaces or future sections for accommodation of future loads. Spare fuses shall be provided for switchboards equipped with fused switches. Where known loads are anticipated in the near future, space, spare units, or space for future section shall be provided. Switchgear assemblies shall be arranged so that additional sections may be installed.
4. Bus bracing shall be indicated on drawings and be greater than the calculated maximum available short circuit current.
5. Overcurrent Protection - Overcurrent protective devices shall be selected to provide continuity of service. Selection of overcurrent protective devices for low-voltage switchgear

assemblies shall be made on the basis of load current, available fault current, and selective operation. The Owner prefers circuit breaker devices over fusible devices. Therefore, circuit breakers should be used wherever possible. Fuses may be used wherever it is required for available faults, to limit fault levels downstream, for proper coordination, for motor protection, where current limiting circuit breakers are not economically feasible, etc. Recommendations for the use of fusible devices shall be submitted to the Owner through the Project Manager for review and consideration.

a. Low-voltage Insulated Case Power Circuit Breakers - Insulated case power breakers in metal-enclosed switchgear may be used when trip rating is above 800 amperes.
b. Molded-case Circuit Breakers - Breakers with fixed mounting may be used in switchboard when trip ratings are not over 800 amperes and their interrupting capacities, with or without current-limiting devices, are adequate.
c. Fused Switches - Determine the rating of fuses and switches, based on voltage, current carrying capacity, and interrupting capacity. Take into consideration motor starting and other forms of inrush current.
d. Coordination - Fuses must be coordinated with all other circuit protective equipment in the system. Use current-time curves of all devices in the system, from the source to the fuse.

C. Panelboard Requirements:
1. Panelboard Schedules
a. A typical three phase panel schedule shall indicate the following: (Single phase panels shall be described on a similar schedule except with only two VA Load/phase columns)
1) Panel designation
2) Quantity of conductors
3) Voltage
4) NEMA enclosure rating
5) Mounting
6) Rating of panel mains
7) Main circuit breaker size
8) Main lug only rating
9) Circuit use
10) Circuit breaker size and pole quantity
11) Circuit load in VA
12) Load totals per phase
13) Connected load totals per type
14) Diversities
15) Design KVA
16) Design amperes
17) Sub-totals
18) Reserve/spare capacity
19) Total connected and diversified loads
20) Notes

21) Required integrated short circuit rating (ISCR)

2. Panelboard Designations - The following switchboard and panelboard designations shall be used where possible:

Description	Designation
Main Switchboard	MSB
Main Distribution Panelboard	MDP
Distribution Panelboard	DP
Panelboards	Single

Multiple Panel	Panels
120/208V Single Story or Building	L,LA,LB,etc.
120/208V Multiple Stories or Buildings:	P1,P1A,L1, P2,P2A,L2.
277/480V Single Story or Building	HA,HB,etc.
277/480V Multiple Stories or Buildings:	H1,H1A,H1B, H2,H2A,H2B, H3,H3A,H3B.

3. Emergency Panelboards - Emergency panelboard designations shall be the same as for panelboards, only with an E in front (i.e., EP, EL, EP1, etc.)
4. Quantity of conductors indicates the number of phases and neutral, if any, that are associated with the panel. They shall be shown as 3 for 120/240V/1 and 4 for 120/208V/3 and 277/480V/3 .
5. Voltage shall be displayed in its proper location and a neutral conductor indicated when applicable.
6. NEMA enclosure rating (i.e., 3R or 1) shall be stated.
7. Mounting (surface or flush) shall be identified.
8. Panel bussing ampacity shown in the space provided shall comply with the standard ratings available from most manufacturers.
9. When required, a main circuit breaker size shall be indicated.
10. When a main circuit breaker is not required, the main lug rating shall be shown.
11. Indicate the required integrated short circuit rating.
12. The circuit designation shall show the type of load being served (i.e., L = Lighting, A = Air Conditioning, etc.) and the specific location of the load (i.e., L-CORR. 123, OFFICE 456, or R-CLASSROOM 789 or M-AHU-1). L-LIGHTING or R-RECEPTACLES will not be acceptable.
13. Device/poles shall indicate the circuit breaker ampacity rating and quantity of poles (i.e., 30A/3P).
14. Circuit load shall be shown in VA and any power factor must be introduced into the load prior to placing it in this column.
15. Three spaces have been provided at the bottom of the VA Load/Phase columns. The loads per phase shall be totaled and the sum entered in KVA in these spaces. The figures shall be compared and the phases balanced to within a nominal 10% of each other where practical

to insure proper feeder and overcurrent protection sizing. Circuits may have to be reassigned to different phases to accomplish this task. The Design Engineer shall use good engineering judgment in balancing phases and sizing feeders and overcurrent protection.

16. The connected KVA shall be totaled on a per type basis at the bottom of the schedule. All loads indicated in the circuit use columns with a common prefix shall be totaled under the corresponding heading.
17. Load demand shall be identified and the figures entered in the diversity column.
18. The demand percentages shall be applied to the connected load totals and the design KVA shown in the appropriate location.
19. The design amperes shall be determined by dividing the design KVA by the panel voltage (line to line) and 1.732 if the panel is three phase.
20. The lighting volt-amperes per square foot as selected from the NEC shall also be entered in the remarks box. A comparison between the connected KVA lighting load the total of the lighting VA/square foot multiplied by the square footage served shall be made. The larger of the two figures shall then be entered in the lighting design KVA space.
21. All columns shall be sub-totaled and sums shown in these spaces.
22. The reserve/spare capacity shall be determined and entered.
23. The percentage shall be used to resolve the total ampacity and KVA load of the panel.
24. The square footage served by the panel shall be shown in the remarks box.
25. A space for notes has been provided and may be used to call attention to any information that may affect the panel.
26. General
    a. 1, 2 and 3 pole breakers shall be grouped for simplicity.
    b. A minimum of 20% spare capacity (spares/or spaces) shall be provided where practical. Spare capacity in bussing and feeder shall correspond to the number of spares or spaces.
    c. When more than 42 poles are required, separate panels should be provided. 54- circuit panelboards may be used but will have to be approved by the Project Manager.
    d. Panelboard shall be hinged trim type.
27. Conductor Sizing: The Design Engineer shall consider the following when sizing feeder conductors.

D. Busway, Feeder and Plug-In

1. Feeder and plug in busway shall consist of insulated conductors totally enclosed in a nonventilated, fabricated, code gauge steel housing. Unless otherwise indicated, feeder duct having ventilated housing will not be acceptable. Busway shall be of the rating indicated on the drawings, and shall be complete with all necessary fittings, power take offs, firestops, hanging devices, grounding bus, wall and floor flanges, and accessories. Components of the busway system shall be UL listed and labeled for mounting in horizontal or vertical position.
2. Joints shall be one-bolt. The bolt shall be torque indicating, fully insulated, and at ground potential. Access shall be required to only one side of the busway for tightening joint bolts. It shall be possible to remove any one length in a run without disturbing adjacent lengths.

Bellville washers in combination with flat washer shall be provided at all bolted connections to ensure joint torque integrity. Contact surfaces at joints shall be silver plated.

3. The housing for indoor busway shall be fabricated of code gauge steel bonderized both inside and outside, and finished in gray baked-on enamel. The housing for outdoor busway shall be fabricated of code gauge galvanized steel and provided with drain holes fitted with rubber drain plugs. Splice joint channel covers shall be provided at each joint and outdoor duct shall be gasketed. A ground bus shall be provided within the busway enclosure with no steel parts between the phase and ground return paths. The ground bus shall be as close as possible to the phase conductors for minimum reactance and shall be electrically connected to the housing at each joint.
4. Bus bars shall be 98% conductivity copper with a rectangular cross-section and rounded edges. The bus bars shall be insulated their entire length except at joints and contact surfaces with a UL approved 105ºC. PVC insulating material. The ground bus shall be tin- plated over its entire length except at contact surfaces where they shall be silver- plated.
5. The busway assembly shall be such that it will provide a compact low reactance, low impedance, low voltage drop bus system. The bus bar assembly shall withstand short circuit stresses in accordance with NEMA short circuit ratings for busways.
6. The busway shall be so designed and tested that at full rated load no part shall exceed 55ºC. above a maximum ambient temperature of 40ºC. in any position. The busway shall be able to withstand for one minute without breakdown the application of 2200 volts of 60 cycle alternating potential between conductors, and between conductors and enclosure.
7. Plug-in Openings: On plug-in type busway, a suitable support shall be provided at each plug-in opening to provide protection of the duct in the event of stresses due to a fault and to provide full isolation of the stabs of any plug-in device installed on the duct. When an internal ground bar is included in the busway, the plug-in support shall also provide for its positive engagement by the grounding stab of the plug-in device.
8. Plug-in Units: Provide plug-in units of the types and ratings indicated on the drawings. Plug-in units shall be mechanically interlocked with the busway housing to prevent their installation or removal while the switch is in the ON position. The enclosure shall make positive ground connection to the duct housing before the stabs make contact with the bus bars. A ground stab shall be provided to engage the busway internal ground bar. Units shall be equipped with a defeatable interlock to prevent the cover from being opened while the switch is in the ON position and to prevent accidental closing of the switch while cover is open. Provide with a means for padlocking the cover closed and the disconnect device in the OFF position. The operating handle and mechanism must remain in control of the disconnect device at all times permitting its easy operation from the floor by means of a hookstick or chain. Units shall be equipped with a means for direct positioning or hanging, so that the weight is born by the duct before the stabs make contact with the bus bars. For safety reasons, no projections shall extend into the busway housing other than the plug-in stabs. Units shall be interchangeable without alteration or modification on all ratings of plug-in duct.

E. Generally use 60 degrees C. ampacities for wire sizes No. 12 through 1 AWG and use 75 degrees C. ampacities for wire sizes No. 1/0 AWG and larger. The following exceptions are required in order

to limit the conductor temperature at the terminations of the circuit breakers and switches to that allowed by Underwriters Laboratories:

1. Use 60 degrees C. ampacities for circuit breakers rated 125 amps or smaller.
2. Use 60 degrees C. ampacities for switches rated 100 amperes and less.

F. All feeder sizes shall be checked and sized for acceptable voltage drop per NEC. The equipment grounding conductor also must be up-sized for voltage drop when the phase conductors are increased.

G. When sizing conductors for underground feeders, the National Electrical Code shall be used for conductor ampacities.

H. All conductor ampacities shall be derated for ambient conditions as follows.

1. 330 degrees C. ambient shall be used for underground feeder conductors.
2. Use 40 degrees C. ambient temperatures in all non-conditioned spaces.
3. Use 40 degrees C. ambient temperatures for all outdoor locations where the conductors are always shaded.
4. Where conductors are exposed to direct sunlight, an ambient temperature of 50 degrees C. shall be utilized.
5. Use 50 degrees C. ambient temperature for conductors located in all uninsulated attic spaces.

I. The neutral shall be considered a current carrying conductor and the feeder derated for more than three conductors in a conduit where applicable, if the majority of the load on the circuit is electrical discharge lighting or data processing equipment or dimmer equipment or other similar equipment producing harmonic currents.

J. Note that double derating is required by the National Electrical Code, so that whenever ambient temperature exceeds that given in the Tables and there are more than three current carrying conductors in a conduit, both derating factors must be applied.

K. Each Design Engineer will be responsible for performing feeder calculations and keeping documentation of these calculations in their design notebook.

L. Standard dry type transformers - Refer to “SECTION 262200 - LOW-VOLTAGE TRANSFORMERS” for additional requirements.

M. The NEC gives requirements for overcurrent protection for transformers rated 600 volts or less such as the typical 480 volt Delta primary 120/208 volt secondary dry type transformer to be used on Alamo Community College District projects.

N. The NEC requires that every panelboard supplied through a transformer be furnished with overcurrent protection on the secondary of the transformer. This overcurrent protection on the secondary can be a fused disconnect, an enclosed circuit breaker, or a main circuit breaker in a panel. A main breaker in the panel meets the requirements for protection of the panel, but the

transformer secondary conductors must also be protected in accordance with NEC, i.e., the transformer secondary conductors must be protected where they receive their supply unless they meet the requirements of the Tap Rule exceptions.

O. Power One-Line - A single consolidated power one-line diagram shall be provided and shall include as a minimum the following:
   1. Transformer/substation, etc.
   2. Secondary cable or bus.
   3. Main and branch panels.
   4. Swtchboards and motor control centers.
   5. Large motors.
   6. Generators.
   7. Automatic transfer switches.
   8. Metering.
   9. Grounding.
   10. Protective/control devices.
   11. Feeders for above equipment with wire and conduit size noted.
   12. Notes:
      a. Provide a separate grounding plan or diagram where grounding/lightning protection system is extensive.
      b. Description of major primary equipment (cable, transformers, switches, regulators, etc.) shall include complete electrical ratings on drawings for record purposes.
      c. Show the electrical (not physical) connections of equipment adequately so that fault calculations can be made.

P. Voltage Drop
   1. Voltage drop calculations should be made for all feeders and long branch circuits. Voltage drop calculations should be made using IEEE 241.
   2. The maximum demand load voltage drop shall be 5 percent.
   3. It normally should be apportioned 1 percent to service entrance and service drop, 1 percent for panel feeder, and 3 percent for branch circuit wiring. These percentages can be varied so long as the 5 percent total is not exceeded.
   4. Starting motor voltage drop calculations should be made for large motors. Calculations shall show each significant motor KVA inrush requirement in comparison with electric supply limitations, and resultant starting voltage drop at the associated switchgear assembly that serves lighting feeders. The voltage dip due to starting inrush should not exceed that stated in section on Mechanical Systems.

Q. Fault Current
   1. The available short circuit current shall be calculated for all projects having services over 150 KVA at 480 volts or 50 KVA at 208 volts. Short circuit calculations should be based on the maximum future anticipated service.
   2. The calculations should assume an infinite bus on the primary of the service transformers.

3. For preliminary design, the service transformer impedance values listed for service transformers in the primary distribution section should be used. Final values shall be obtained from the campus infrastructure engineer during Construction Drawings (CD's) based on actual transformer impedances.
4. Motor contribution to fault current shall be included.
5. All equipment and overcurrent devices shall have an interrupting capacity as required by NEC based on the fault current calculations.
6. The integrated short circuit ratings of all electrical equipment shall be indicated on one-line diagrams and panelboard schedules.
7. A fault current schedule shall be included with the one-line showing the available fault current at all major equipment.
8. Where fuses are chosen to furnish fault current limitation for downstream equipment, this shall be specifically noted on the Drawings and required nameplates. Fuse and breaker series combinations shall be selected in accordance with U.L. Recommended Component Directory - Circuit Breakers - Series Connected or comply with the downstream equipment manufacturer's recommendations.

R. Overcurrent Protection Coordination

1. The Design Engineer shall coordinate the main feeder and subfeeder protective device trip characteristics so that they will clear or trip before the upstream main and primary transformer overcurrent protective device.
2. The Design Engineer shall consider additional coordination for branch devices where continuity of service to building loads is critical.
3. For new buildings, select the devices which provide the best selectivity/coordination, thereby minimizing the areas of outages. Special device settings shall be indicated on the Drawings.
4. For existing systems, make recommendations which will improve system selectivity to the Project Manager. Include estimate of cost with recommendations.
5. Standard dry type transformers - Refer to “SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY” for additional requirements.

S. Final Load Analysis

1. The final load analysis represents the Design Engineer's compilation of the project's electrical loads and demand factors. It shall be included as part of the Contract Documents on each project.
2. All panelboards, switchboards, motor control centers, etc. shall be totaled according to type of load.
3. Not all of the connected load will be used at the same time. Therefore, a "demand" factor may be applied to represent the actual maximum demand to connected load ratio. This ratio is expressed as a percentage of the connected load. The National Electrical Code (NEC) specifies the allowed lighting load feeder demand factors. The NEC also contains demand factors for non-dwelling receptacle load and shall be used by the Design Engineer as appropriate.

4. A step-by-step procedure for calculating the net overall demand load of a typical building would be:
   a. Total the connected load of each load group - lighting, general utility, building power, air conditioning, production equipment, kitchen equipment, special loads, etc.
   b. Multiply the connected load of each group by the appropriate demand factor to get the total present demand.
   c. Add the estimated future load to the overall demand.

T. Non Linear Loads
1. Provide 200% Neutral Bus Bar sizing on Panelboards serving Non Linear loads.
2. Provide dedicated neutral for branch circuits.
3. Utilize K-13 type Transformers with 200% Neutral conductors to Panelboards.
4. Provide as a Separate System from Normal General Purpose power.
5. Special consideration shall be given to buildings with extreme harmonic generating loads (i.e., Computer Labs, Data Centers, etc.). A true harmonic suppression system shall be considered as an alternate design. The design engineer shall provide the owner with a statement of probable cost for this system including potential energy savings and payback time. Final decision shall be made by the owner.

END OF SECTION 26 00 03

SECTION 26 00 04 – EMERGENCY POWER DISTRIBUTION SYSTEM REQUIREMENTS

PART 1 - Emergency Power Distribution System Requirements

A. Emergency power systems shall be provided as required by the local building codes or good design practice. The Design Engineer will make recommendations for the most appropriate emergency system for each project during Schematic Design. Recommendations should include a cost estimate for the recommended system.

B. The emergency power systems shall be designed in accordance with Standard ANSI/IEEE STD 446-latest edition, entitled IEEE Recommended Practice for Emergency and Stand-by Power Systems for Industrial and Commercial Applications, NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, and NFPA 110, Standard for Emergency and Stand-by Power Systems.

C. New Buildings: An emergency generator shall be considered for all new buildings above seventy-five thousand square feet, unless a more beneficial solution can be derived. An emergency generator shall also be considered for any building that is of "critical use" in nature, the design engineer should coordinate with the owner.

D. Batteries shall not be used for emergency power.

E. Refer to section

F. Existing Buildings
   1. Where emergency systems are required, an emergency generator is the preferred source instead of battery packs. The Design Engineer shall study the feasibility of retrofitting a generator set and present his findings to the Owner through the Project Manager for review and consideration.
   2. The Engineer shall evaluate the existing equipment and specify replacement or repairs as necessary.
   3. The age of existing batteries shall be determined. Batteries at or near their rated useful life shall be replaced.
   4. Existing emergency systems in renovated areas shall be upgraded to meet current code requirements.

G. Generator Set
   1. Refer to specification 26 32 13 "Diesel-Engine Driven Generator Sets" for additional Generator Set requirements.
   2. An engine generator shall be provided for all new buildings where an emergency power source is required by code as follows:
   3. ≤250 kW – Diesel or Natural Gas
   4. >250 kW - Diesel

5. Careful consideration shall be given to proper ventilation, fuel system details, noise, exhaust location, and ease of maintenance.
6. Provision for remote monitoring by the building fire alarm system shall be made.

H. Automatic Transfer Switch (ATS)

1. Manufacturers: Caterpillar, Generac, Cummins, Onan.
2. Warranty: One year from substantial completion date.
3. An automatic transfer and bypass isolation-switch shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch that could not otherwise be tested and maintained without interrupting the load. Bypass of the load to either the normal or emergency power source with complete isolation of the automatic transfer switch shall be possible regardless of the status of the automatic transfer switch. The bypass isolation switch shall permit proper operation by one person through the movement of a maximum of two handles at a common dead front panel. The entire system shall consist of two elements: The automatic transfer switch and the by-pass-isolation switch, furnished completely factory interconnected and tested.
4. Each switch shall be electrically operated and mechanically held in each direction by a single solenoid mechanism momentarily energized from the source to which the load is to be transferred. Switch shall be inherently double-throw with both sets of main contacts moving simultaneously. Mechanical or electrical interlocking of single-throw devices such as circuit breakers, or motor starters is not acceptable. Disarrangement of any part or failure of any coil shall not permit a neutral position and shall not permit both sides to be closed at the same time. Molded plastic parts shall not be a part of the driving mechanics. The mechanical interlocks and driving mechanism shall be electrically dead.
5. Switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
6. Switches shall not consist of adapted devices which were not originally intended to repeatedly open and close on load current to 600 percent of rated at 0.40-0.50 power factor in accordance with test procedures of U.S. Standard # 508 Tenth Edition (Industrial Control Equipment).
7. Main contacts shall be silver-alloy protected by ARC barriers and ARC quenchers. All sizes shall have separate Arcing contactors.
8. Switches shall meet or exceed the following standards using the original set of main contacts for all requirements. These requirements shall be met without cleaning and/or adjusting between any of the tests. All switching shall be performed at the rate of 6 operations per minute between two 480 VAC sources which are 120 degrees out of phase. The time of transfer in either direction shall not exceed 1/15 second and the power factor for all tests shall be 0.40-0.50. One operation shall be considered as transfer of the load from normal to emergency followed by retransfer of the load back to normal.
   a. Endurance: Minimum of 6000 operations at 200 percent of rated current.
   b. Overload: Minimum of 50 operations at 600 percent of rated current.

c. Temperature Rise: Following the endurance and overload test the temperature rise of the main contactor shall not exceed allowable NEMA standards of 65 degrees C when carry rated current while installed in a non-ventilated enclosure.

9. Provide fully-rated neutral transfer contacts where neutral conductors must be switched.
10. Provide a neutral terminal plate with fully-rated pressure connectors where neutral conductors are solidly connected.
11. Controller shall be microprocessor based with serial communications capability.
12. Provide with voltage and frequency sensing, adjustable relays. Voltage sensing relays located across each phase of the normal source shall detect failure when any one phase drops below 70% of rated voltage and sense restoration of normal when all phases have returned to 90% or more of normal rated voltage. A voltage-frequency relay shall prevent transfer of the load until the emergency source reaches at least 90% of rated voltage and frequency.
13. Shall have adjustable time delay features for override of momentary normal source outages, transfer to emergency source, retransfer to normal source, and cooldown on shutdown of engine generator.
14. Provide with two (2) NO/NC auxiliary contacts.
15. Provide indicating lights to indicate when the ATS is connected to the normal source (green) and emergency source (red). Also, provide indicating lights for both normal and emergency source availability.
16. Provide with engine exerciser and in-phase monitor.

I. Individual Unit Battery Equipment

1. Battery back-up shall be provided for small loads, such as fire alarm control panels, emergency lighting, and exit signs where an emergency generator is not provided.
2. LED fixtures shall contain battery packs with self-diagnostics, charging indicator light to monitor charger and battery, and a battery low voltage annunciator
3. All battery-operated emergency lighting units shall be Dual Lite Spectron II Series, having monthly self-diagnostic and self-discharging cycles, in addition to constantly monitoring the charger performance and the battery voltage. The Dual Lite Spectron II Series shall be utilized for all single or two headed emergency units, all LED / fluorescent battery packs, and all battery-operated emergency exits. Spectron II auxiliary communication modules shall be furnished in each building main telephone room as required to monitor the quantity of units used. A Spectron II portable communicator shall be bid as an additive alternate on each project. Alternate units shall be bid as deductive alternate bid items.

J. Connection Ahead of Service Disconnecting Means

1. Connection ahead of the service disconnecting means is not required where unit batteries are provided for exit signs and emergency lighting, or where stand-by generator is provided.

K. Location of Distribution Equipment - Emergency distribution equipment shall be separated from normal equipment to prevent simultaneous interruptions of both normal and emergency power.

L. Conduits and Circuitry

1. Battery powered emergency fixtures and exit lights shall be connected to the same lighting branch circuit that feeds the general emergency lighting (unswitched preferred) in the area. Circuits to battery powered emergency fixtures shall be unswitched unless special conditions dictate otherwise.
2. All emergency wiring shall be installed in separate raceways from normal system wiring. All emergency power system raceways and junction boxes shall be labeled.

M. Additional Design Considerations
1. The emergency power systems shall supply critical systems and equipment only.
2. The following systems should be considered for connection to an emergency power system:
   a. Exit and emergency lighting
   b. Elevators
   c. Refrigeration equipment (including laboratory refrigerators)
   d. Smoke control equipment
   e. Fire alarm control panels
   f. Fire pumps
   g. Data processing equipment
   h. Communications equipment
   i. Signaling circuits
   j. Maintenance support requirements
   k. Designated receptacles and equipment in MDF, IDF, IT, server rooms, etc.
   l. Other designated equipment

END OF SECTION 26 00 04

SECTION 26 00 05 - GROUNDING

PART 1 - Products

1.1 Connectors:

A. Cadweld

B. Burndy Corp

C. O-Z/Gedney

D. Blackburn

1.2 Ground Rods:

A. Cadweld

B. Blackburn

C. Copperweld Corp.

D. Erico

1.3 Material

A. Ground rods: Copper-clad steel rods, minimum 5/8” in diameter by 10-feet long.

1.4 Connections

A. Provide irreversible compression or exothermic weld type connections.

PART 2 - Design Execution

A. Provide ground electrode system at the disconnecting means of each service entrance at each building and at each separately derived system. Install ground electrode system in accordance with NEC Article 250. Connect available and made ground electrodes specified herein to the system grounded conductor (neutral) by means of bonding jumper sized in accordance with NEC. Provide main bonding jumper, sized in accordance with NEC, between the system’s grounded conductor and the equipment ground bus within the service entrance equipment.

B. The service entrance grounding at each building or structure shall be carefully coordinated with the Infrastructure Engineer on each campus. An equipment ground conductor shall not be provided with feeders from the padmount transformer to the building entrance equipment. Ground electrodes shall be provided at both the transformer and as described above at each building.

C. All electrical receptacles, fixtures, equipment, conduit, and support cabinets shall be grounded with a green insulated grounding conductor in accordance with the latest National Electrical Code.

D. All available grounding electrodes, including metal underground water pipe, metal building frames, concrete encased electrodes, and/or ground ring, shall be bonded together to form the grounding electrode system through Exothermic weld or Irreversible Compression type.

E. A made electrode consisting of two 3/4" diameter by 10' long copper clad ground rods located 10'-0" apart minimum shall be provided and bonded to the ground electrode system described above.

F. The Design Engineer shall provide a concrete encased electrode in the concrete foundation of all new buildings by providing a minimum of 20' of bare copper No. 2 AWG conductor in the foundation as described in the National Electrical Code or by bonding to reinforcing bar not less than 1/2" diameter and 20' long.

G. The ground electrode system and ground electrode conductors shall be clearly shown on the plans and details.

H. Provide green an insulated equipment grounding conductor with each feeder and branch circuit.

I. Provide bonding jumper for all raceways and enclosures.

J. Equipment grounding conductors shall be sized and indicated on the Contract Documents by the Design Engineers.

K. Computer terminals and all other sensitive electronic equipment shall be kept separate from general-purpose loads.

L. All raceways enclosing ground electrode conductors and bonding jumpers shall be non-metallic unless required by code to be metal (as in plenums, for example).

M. Swimming Pools, Fountains, and Similar Installations - Grounding and bonding shall be clearly indicated on the Drawings and be designed in accordance with NEC Article 680.

N. Electronic Data Processing (EDP) Centers - Special consideration shall be made regarding grounding of EDP centers. Grounding shall meet NEC and the equipment manufacturer's recommendations.

PART 3 - Testing

3.1 Perform ground resistances test of system grounds, including separately derived systems, using the fall of potential method as recommended by IEEE 81.

END OF SECTION 26 00 05

SECTION 26 00 06 - LIGHTING

PART 1 - Lighting

1.1 Lighting Level Calculations

A. Foot-candle Levels - Foot-candle levels for interiors and exteriors of buildings shall be as recommended by the ACCD Educational Standards. All design foot-candle levels shall be maintained values with all applicable light loss factors taken into consideration.

B. Outdoor Areas -
1. General Parking and Pedestrian Area – Nominal 1 foot-candle minimum and maintained with 4:1 average/minimum uniformity ratio.
2. Vehicle Use Area - 1 foot-candle average and maintained with 3:1 average/minimum uniformity ratio.

C. Average Illuminance Calculations
1. As a minimum, all interior spaces shall be calculated using the "lumen method" (zonal cavity) as described in the IES Reference Volume Chapter 9, to determine the average foot- candle level at a specific work plane in a given room or area.
2. If the Engineer chooses to use a computer program to perform point by point lighting calculations, the information that would have been provided by performing the “lumen method” (zonal cavity) calculation shall be required to be provided as a minimum.
3. Room Reflectance Values
   a. The Engineer should make every effort to obtain room finishes (i.e., color, texture) from the Architect to establish the room reflectance values used in determining light fixture coefficients of utilization. The Engineer should recommend the following IES recommended reflectance’s to the Architect on his project:
   b. Walls, including tack boards and large cabinets or cupboards mounted on the wall, should have no specular surface with from 40 to 60 percent reflectance.
   c. The ceiling should be as nearly white as practicable and no specular, for this surface is most important in reflecting light downward toward tasks on desktops. Ideally, the ceiling should have a luminance greater than, or at least equal to, that of the side walls.
   d. Floors should have a no specular reflectance as high as possible. Floor or floor coverings should be lower in luminance than the walls.
   e. To prevent direct glare, windows must be either located outside the normal field of view or provided with means of control.
   f. Unless sunlight is desired, it usually should be prevented from entering a space, since it can produce areas of excessively high luminance within the space itself.
4. If actual room reflectance information is not available at the time of calculation, the following shall be used as a default until actual values can be determined:
   a. Ceiling - 80%

b. Walls - 50%
c. Floor - 20%

5. Maintenance Factors - The maintenance factor used in the lumen method or point-by-point calculations shall be the product of all known light loss factors applicable to the specific room or area. These factors area as follows:
   a. Ballast Factor (where applicable) - This factor will take into account the difference in lamp lumen output from the standard test ballast and that of the ballast used in each specific fixture application. This information should be obtained from lamp/ballast manufacturers published data.
   b. Lamp Lumen Depreciation - This factor will take in account the lamps decreased lumen output through the life of the lamp. This factor should be derived from lamp manufacturers published data given for light output at 70% of the lamps rated life.
   c. Luminaire Dirt Depreciation - This factor takes into account the accumulation of dirt on the light fixture and its impact on light output from the fixture.
   d. General Factor - This factor will be the product of all the following factors as applicable to the room or area:
      1) Temperature Factor (High or Low Ambients)
      2) Room Surface Dirt Depreciation Factor
6. Point-by-Point Calculations
   a. For calculations for large rooms (i.e., gymnasiums, cafetorium's) or in special fixture applications (i.e., indirect lighting) the point-by-point method of calculation is preferred and shall be used to insure that proper distribution of light in the room or area is provided.
   b. Indirect Lighting Calculations: When performing indirect lighting calculations, actual reflectance values of all surfaces must be determined and modeled accordingly by the design engineer or representative.
7. Outdoor Calculations
   a. Open parking areas, intercampus roadways, and building floodlighting calculations should be performed with the use of manufacturers "Isolux" diagrams or by point-by-point computer calculation programs. In either method of calculation, it is extremely important that the values obtained are maintained (including all applicable light loss factors), not initial amounts. The Design Engineer should include a print-out of the computer program of the building/site plan with foot-candle levels indicated.
   b. Include site and parking lot Point-by-Point calculations on Contract Documents. Tree shadowing shall be considered in design.

1.2 Lighting Fixtures

A. To comply with the Alamo Community College District's desire to use and maintain standard light fixtures throughout the many and varied portions of this project, a number of "Building Standard" light fixtures have been selected.

B. A LED troffer fixture has been selected as the new construction building standard fixture. This fixture shall be used in classroom, offices, and corridor applications. It shall be equipped with a 0- 10V universal voltage dimming driver. Lumen package shall be selected based on lighting design calculations performed per IESNA.

C. The building standard for all other interior light fixtures is LED with a single 0-10V electronic dimming driver.

D. Downlights shall be open bottom type (not lensed) with specular clear alzak reflectors and utilize LED technology. Downlights shall be used for accent purposes and to provide additional light when necessary.

E. LED strips shall be equipped with universal voltage 0-10V dimming drivers. Strips shall be used for cove lighting, mechanical rooms, etc.

F. Parking lot pole mounted luminaires and poles shall be coordinated with fixtures that are existing to remain. They shall be aesthetically selected to complement the campus and any existing lighting.
   1. Lamp shall be LED in a rectangular cut-off type fixture with a NEMA distribution as required for the application. Finish shall be campus specific per ACCD Educational Standards. Coordinate lamp color characteristics with existing campus lighting.
   2. Poles shall be 20'-0" or 30'-0" high, square or round, steel or aluminum, with color finish to match existing campus fixtures. Poles shall be furnished with anchor bolts, bolt templates and matching bolt covers.

G. Wall packs shall be LED, aluminum housing, borosilicate lens and provided with campus specific finish as required by ACCD Educational Standards.

H. Pedestrian walkway lighting shall be pole mounted luminaires and poles as follows:
   1. Luminaire shall be an 18" round refractor globe designed to control glare and direct the light to where it is needed.
   2. Lamps shall be LED. Coordinate lamp color characteristics with existing campus lighting.
   3. Poles shall be 10' to 14' tall round steel with factory applied dark bronze baked enamel finish.

I. All interior and exterior light fixtures shall be UL-listed and labeled for their intended installation application, such as “wet location” listed versus “damp location” listed.

J. Exit lights shall be furnished with a universal mounting canopy, stencil face with red letters and white finish housing. Exit signs shall be LED. Fixtures shall be single face with removable arrow covers. They shall have internal battery back-up with testing ability. Directional Exit Signs shall be placed in every location where the direction of travel to reach the nearest exit is not apparent per NFPA 101.

K. Lensed troffers shall have prismatic pattern lenses with a minimum of 0.125" overall thickness.

1.3 Existing Facilities

A. Areas being remodeled shall be studied on an individual basis. Budget constraints shall govern selection of light fixtures. The Design Engineer shall review existing conditions with a view towards reuse, refurbishing or replacing the existing lighting system. He shall examine each case and provide the Project Manager with recommendations and cost estimates for evaluation. Recommendations and cost estimating should be done on the basis of life cycle costing which takes into consideration first cost, operating cost, etc. This information shall be submitted during the Schematic Design (SD) part of each project. Existing lighting systems may be replaced in their entirety only if it is economically feasible. Where a small proportion of light fixtures must be replaced, fixtures to match the existing shall be used.

1.4 Prebids

A. The Alamo Community College District may request bids from various manufacturers for large lots of the building standard light fixtures. These bids would also include unit pricing to allow future purchases of the same type fixtures if an adjustment of the original quantity estimates is required. During the Schematic Design (SD) phase of the each project, the Design Engineers shall submit lighting layouts and/or estimates of the quantities of building standard fixtures they feel will be required. After quantity estimates are received, the Alamo Community College District may prebid or prepurchase and warehouse the fixtures for future dispersal to the Contractors.

1.5 Specifications

A. One manufacturer will be listed for each fixture type on the Construction Documents' light fixture schedule.

B. At least two alternate fixture manufacturers should be acceptable to the Engineer for each non-building standard scheduled fixture.

C. Special fixtures (decorative) or fixtures that only one manufacturer will satisfy the performance requirements of a room or area, shall be listed as a separate bid item apart from all other fixtures.

D. The light fixture schedule shall include the following information in each column:
   1. Type:
      a. Fixture designation adjacent to fixture symbol on floor plans.
      b. The letters 'I' and 'O' shall not be used.
      c. When schedules use more than 24 letters, double letters shall be used (i.e., AA, AB, AC-AZ, BA, BB, BC-BZ, etc.).
   2. Lamps:
      a. Indicate the quantity and type of lamps required per fixture.
      b. The type of lamp shall be descriptive in that it will state the following:

1) Bulb Shape - A, B, BT, C, CA-9, CA-10, CM, E, ER, F, FB, FC, FCM, FM, G, P, PAR, PS, R, S, STC, T, etc.
2) Bulb Size - Diameter in increments of 1/8".
3) Wattage.
4) Bulb Coating (or lack of) - CLEAR, IF (Inside Frosted), CW (Cool White), WW (Warm White), DIFFUSE, PHOSPHOR COATED, etc.
5) Burning position where applicable.

3. The third column shall indicate the mounting location of the fixture. It shall state that the fixture is to be recessed, surface, ceiling, wall or pole mounted or any combination of mountings that apply. Mounting height or pole height shall also be stated in this column when applicable.
4. Voltage requirements of the fixture shall be shown in the fourth column.
5. The fifth column of this form shall contain a complete and detailed description of the fixture. The description shall include the manufacturer, the correct catalog number, the type of fixture, i.e., LED, fluorescent, low voltage, light track, etc., any special finishes or features, and all characteristics that will be required in order to produce the lighting design intended, i.e., photometrics, beam angles, lens types with penetrated and unpenetrated depth indicated, maximum overall depth and size of fixture, spacing requirements, etc.
   a. In all, this column must thoroughly describe the fixture that the lighting design was based upon. This will help the contractor to bid equals and the construction administrator to review fixtures submitted as equals to the fixture used for design.
   b. Copies of manufacturer's data sheets of selected fixtures shall be kept in the project file. All outstanding features shall be highlighted.
6. Lamp and Driver Types – 0-10V dimming drivers shall be specified for all LED fixtures. LED lamps shall have a color Temperature of 4100 K.

E. Fixture Installation and Mounting Details
1. The Coordinating Engineer will provide typical details for fixture installation and mounting where applicable.
2. The Design Engineer shall provide any additional details as required to clearly describe how to install or mount light fixtures used on the project.

1.6 Lighting Design Considerations

A. Lighting Design shall be coordinated with Project Architectural Reflected Ceiling Plans (RCP's) and the ACCD Educational Standards.

B. The rooms/areas and lighting layouts are generic in nature and are furnished to establish typical light fixture orientation and spacing only. It is the responsibility of the Design Engineer to perform lighting calculations for each room and design the lighting to conform with the actual rooms and architectural configurations for his project.

1.7 Lighting Controls

A. Incandescent lighting shall not be allowed in any ACCD facilities.

B. All interior and exterior lighting shall meet or exceed the energy saving lighting control standards as set by the latest I.E.C.C. This includes, but is not limited to,
   1. Where required by C405.2.1.1, provide vacancy sensors with manual ON / auto OFF control.
   2. Where required by C405.2.2.1, the time-switch control required override switch shall permit that the controlled lighting to remain ON for 2 hours.
   3. Where required by C405.2.2.2, light-reduction controls shall be manually controlled to allow the occupant to automatically dim all luminaires to 50% of full brilliance.
   4. Provide daylight-responsive controls for as required by C405.2.3.

C. In corridors and common public areas, all normal lighting (not emergency or security) shall be controlled through a timeclock or lighting control panel.

D. Use of three-way light switches should be minimized.

E. In large rooms or areas with more than one lighting circuit, ganging of switches (single or three-way) should be avoided through use of relays or contactors.

F. The lighting designer shall obtain direction from Owner during programming of the project as to the Owner's preference for the use of EMCS-controlled lighting contactors to meet IECC interior lighting requirements for each type of space.

G. The lighting designer shall obtain direction from Owner during programming of the project as to the Owner's preference for the use of photocell, timer, or EMCS-controlled lighting contactors to meet IECC exterior lighting control requirements.
   1. It may be desirable to turn off one group of exterior lights separately and at a later time from another group of exterior lights. Lighting designer shall obtain direction from Owner during programming of the project as to the Owner's preference.

H. Parking lot and area lighting fixture control shall be coordinated with the Project Manager. Control by Photocell through electrically-held lighting contactors. Provide lighting contactors with an override switch. Provide Photocell/On/Off control for all night security lighting.

I. Other factors being equal, photocells shall face north and shall be serviceable from a standing position or a ladder not taller than 10'-0". Photocells used where aesthetics are important shall be flush mounted and in a location easily accessible for maintenance personnel.

1.8 Emergency and Security Lighting

A. Emergency Lighting
   1. Emergency egress lighting shall be provided along all paths of egress in the building.

2. Emergency lighting shall be circuited to the emergency electrical system if one has been provided or exists, i.e., a central battery system or an engine generator.
3. If an emergency electrical system is not available, selected LED fixtures with battery pack units or self-contained emergency lighting units shall be specified to provide a minimum of one foot-candle along all paths of egress.
4. Emergency and exit lighting shall be placed on "unswitched" circuits.
5. Refer to Section 26 00 06 for stand-by power requirements.

B. Security Lighting (Night Lighting)
1. Security lighting in interior spaces shall be comprised of selected fixtures connected to unswitched circuit wiring.
2. In most cases, the light fixtures used for emergency lighting can also serve as security lighting.
3. In areas that do not have LED fixtures for emergency lighting, adequate fixtures shall be selected to be placed on unswitched circuit wiring.
4. Connect additional fixtures to unswitched circuit wiring in areas having high security requirements as instructed by the Owner.

END OF SECTION 26 00 06

SECTION 26 00 07 – GENERAL POWER REQUIREMENTS

PART 1 - General Power Requirements

A. General power may be described as miscellaneous duplex receptacles throughout the project that are not assigned to serve a specific device or piece of equipment. Special purpose outlets are receptacles other than 120 volt, NEMA 5-20 configuration outlets, such as twistlock or 208 volt receptacles.

B. Receptacle locations will vary according to the use of space.
   1. Classrooms for instance, should have as a minimum one general power duplex receptacle centered on each wall.
   2. In multi-desk offices, a minimum of one quad-plex receptacle shall be provided at each administrative desk location with at least one duplex receptacle on other walls.
   3. In one-person offices, provide a quad-plex receptacle on the wall adjacent to the preferred desk location. Provide a minimum of two other duplex receptacles in the office.
   4. Corridors should have receptacles or special purpose outlets located approximately 30'-0" on centers for cleaning equipment.

C. Receptacle densities should be adjusted to suit the application. Lab areas will require more outlets per square foot than gymnasiums.

D. Ground fault circuit interrupting receptacles shall be used in lieu of GFCI circuit breakers. They shall be installed in all locations where the possibility of serious electrical shock may exist. Receptacles located adjacent to sinks, exterior outlets, toilet rooms, etc. are typical locations. Using a single GFCI receptacle and “pig-tailing” non-GFI receptacles is not allowed.

E. Receptacles with weatherproof covers shall be installed on all exteriors for use by maintenance personnel. They should be mounted a minimum of 2'-0" above finished grade. Maximum spacing shall be 100' for outlets at grade level.

F. Coordinate all receptacle locations with casework, chalkboards, etc.

G. Specification commercial grade, 20A, 125-volt, grounding type, duplex receptacles shall be specified.

H. Approximately six to eight general purpose duplex receptacles shall be connected to the same circuit. Care shall be taken not to connect outlets dedicated to specific equipment on a general use circuit.

I. All wiring device coverplates shall be stainless steel Type 430.

J. Special purpose outlets shall be designated as shown on the symbols schedule. The specific NEMA configuration shall be indicated and the use or equipment served shown adjacent to the outlet.

K. Indicate mounting heights of devices other than 15” A.F.F to center of receptacle.

L. Whenever dedicated circuits are required, the equipment served shall be identified next to the outlet location.

M. All computer outlets shall be circuited together and contain standard duplex type receptacles.

N. Electric drinking fountains shall be provided a GFCI duplex receptacle located behind the housing. A cord and cap shall be furnished and installed when required.

O. To prevent sound transmission between rooms, no outlets shall be installed "back-to-back".

P. On new construction when floor outlets are required, flush floor outlets are preferred over tombstone type. Tombstone type shall not be used without specific Alamo Community College District approval. On existing construction, core drilled, fire rated flush "poke-thru" type outlets shall be installed.

Q. Use of power poles shall be minimized.

R. Wiring devices shall be commercial specification grade.

S. Surface mounted raceways such as Wiremold (5400 Series), or approved equal, shall be specified complete with all components. All installations shall have a ground conductor within the raceway and all outlets shall be grounded. Note, surface mounted raceways shall only be used when specifically requested by owner, or when required in “existing to-remain” construction.
   1. Shall be a non-metallic, raceway system used for branch circuit wiring and telecommunication wiring.
   2. Raceway shall have two wiring channels separated by one integral barrier. Each channel shall be large enough to accept standard power and communication devices without restricting capacity of the adjacent channel.
   3. Raceway system shall be provided with device brackets and plates for mounting of receptacles and telecommunication devices.
   4. Raceway system shall be provided with fitting and accessories for a complete and functional system.

END OF SECTION 26 00 07

SECTION 26 00 08 – COMMUNICATION RACEWAY SYSTEMS

PART 1 - Communication Raceway Systems

1.1 Communication One-Line Riser Diagram:

A. This shall include as a minimum the following:
   1. Building stub out and/or connection to existing system
   2. Backboards
   3. Outlets
   4. Conduit runs
   5. Cable

1.2 Conduit and cable may be shown as typical.

A. Communication conduits shall be routed inside ceiling, floor, and wall cavities to the greatest extent possible. Surface mounted conduit shall be used only when there is no other route to provide service to the desired location. Do not route conduits in or under slab.

B. All conduit ends shall have plastic bushings installed before the cable is pulled into the conduit.

C. All conduits and cables that penetrate fire rated walls or floors must be fire stopped.

D. Communication conduits and cables shall maintain the following minimum separation distance from electrical power feeders:
   1. For power systems operating at 480V or above, such as electrical distribution panels, step down transformers, maintain a minimum separation distance 20’-0” from all telecommunication cross-connects.
   2. For power systems operating at 480V or above, such as electrical distribution panels, step down transformers, maintain a minimum separation distance 10’-0” from all telecommunication cabling. Pathways should cross perpendicular to electrical power cables or conduits.
   3. For power systems operating at below 480V, including all conduit and cables used for electrical power distribution, maintain a minimum separation distance of 2’0” from all telecommunications cabling. Pathways should cross perpendicular to electrical power cables or conduits.
   4. For branch circuits (secondary) power (120/240V, 20A) where electric light or power circuits coexist with telecommunications cabling, maintain a minimum separation distance of 2”.

1.3 Telephone Backboard - In general the following minimum guidelines apply:

A. Provide 20"W x 30"H backboard for up to six (6) single line handsets.

B. Provide 4' x 4' backboard for up to sixteen (16) six button stations.

C. Provide 4'W x 8'H backboard for up to thirty-two (32) six button stations.

D. Clearance - Provide 3' of clear space in front of backboard.

E. Power - Provide a single dedicated 120V, 20A, circuit feeding 2 duplex NEMA 5-20R receptacles mounted on the top right side of the backboard. (1 - duplex receptacle is adequate for a 4' x 4' backboard or smaller.) This circuit shall be an emergency circuit when an emergency generator or battery invertor system is provided.

F. Grounding - Provide #6 bare copper ground wire from backboard to building ground, and at backboard coil up minimum of 5' (i.e., enough to reach any location on backboard).

1.4 Conduit to Outlets - Provide 3/4" conduit minimum to each outlet. Consult the following chart when more than one outlet is fed through a single conduit.

Conduit Size	Maximum Number of Outlets
3/4"	1
1"	2
1-1/4"	4
1-1/2"	5
2"	8

1.5 Service Entrance - Provide 4" conduit minimum for service entrance. This conduit may be one of the four 4" conduits mentioned in Section 26 00 18.

1.6 Conduit Risers and Sleeves

A. Minimum size 4".

B. Sleeves should be vertically aligned to permit pulling of cables.

C. Initial unused sleeves and conduits should be capped and marked.

D. Sleeves should be stubbed 4" above the finished floor.

E. Sleeves should be located immediately adjacent to the wall and to the left of the cable terminating space. They should never be designed to be located close to or in the center of the terminal board.

F. Supporting Facilities (Utility Interface)
1. Supporting facilities shall include an empty conduit/duct system installed underground from the main backboard to communication manhole.
2. Outlet Locations
3. In individual offices, locate the telephone outlet directly behind the preferred desk location.
4. In multi-person offices, locate a telephone outlet adjacent to every desk location.
5. Coordinate location of other outlets as required with the Project Architect.
6. All outlets shall be installed vertically.
7. Provide public access pay telephone outlets at lobbies, corridors, lounges, etc. Install outlets at 36" above finished floor to comply with handicapped access requirements.

G. Wire and Cable
1. Specification of wire and cable for this system will have to be coordinated with the Project Manager and Alamo Community College District.

1.7 Wall Outlets

A. All wall outlets shall be mounted in a minimum four (4)-inch by four (4)-inch by two and one-half (2 ½)-inch deep double gang outlet box. Provide with single gang ring plate.

END OF SECTION 26 00 08

SECTION 26 00 09 – ELECTRICAL DESIGN FOR MECHANICAL EQUIPMENT

PART 1 - Electrical Design for Mechanical Equipment

1.1 Motor Voltages:

A. Motors 5 HP and larger shall be 480 volt, 3 phase. Motors from 3/4 HP up to and including 3 HP shall be 208 volt, 3 phase. Motors 1/2 HP and smaller shall be 120 volt, single phase. 277 volt, single phase motors may be used for VAV boxes and other such equipment that is normally rated for 277 volts. The motor voltages, of course, shall be modified as dictated by the power distribution system voltage within the building, i.e. if 480 volts is not available, then the motor should be specified for the voltage that is available. Deviation from these voltages is also permissible where a manufacturer of the particular equipment does not provide motors in that particular voltage. Consideration to the availability of motors stocked normally in a particular voltage should be made in selecting the equipment voltages.

1.2 Motor Control Centers

A. The design engineer shall provide motor control centers in lieu of separately mounted motor starters where several motors are located in close proximity and it is economical to doso.

B. The mechanical design engineer shall be responsible for specifying proper types and sizes of motors and for indicating their locations on the drawings. This information shall be provided to the electrical design engineer who shall indicate suitable motor starter types, size, and feeder sizes. The electrical design engineer shall select line voltage and other electrical characteristics in conjunction with the mechanical design engineer.

C. Busses and Connections

1. Three horizontal main bus bars shall be provided at the top of each section and shall run continuously through the motor control center. Each section shall contain three vertical bus bars running the full working height of the section and connected to the horizontal bus.
2. Buses and electrical connections shall be rated 600 volts A.C., consist of hard drawn copper, and be mounted on insulated supports. The buses, insulators and their supports shall be designed and constructed to withstand the mechanical stresses and the electromagnetic forces imposed for the maximum short circuit current available. The main horizontal bus shall be rated at 600-amps minimum, and the vertical bus shall be rated at 300-amps minimum. The other current carrying devices shall have sufficient capacity to supply full rated power continuously to the various control units without overheating in an ambient temperature of 40ºC.
3. Vertical buses and plug-in clips shall be tinned or plated copper. Splicing connections in the buses and tap connections to the buses shall be drilled or punched before the contact surfaces are plated. Provisions shall be made in the design for the expansion and

contraction of the current carrying conductors and the metal housing due to temperature changes.

4. Provide separate copper busses for ground and neutral. Each bus shall run the full length of the motor control center.

D. Control Central Units, Plug-in Type

1. Control units shall be rated 600 volts A.C. and be installed inseparate compartments.
2. Circuit breaker or switch operating handles shall be interlocked with the door so that the door cannot be opened with the device in the closed position except through a hidden release mechanism which shall be provided for use by authorized personnel. The operating handle shall be arranged for padlocking in the OFF position with up to threepadlocks.
3. The starter units shall be equipped with three Class 20 manual reset thermal overload relays and heaters, control power transformer, and 120 volt operating coils, unless otherwise noted. One side of the secondary of the control transformer shall be grounded; the line side shall be fused. Transformers shall be sized for the operating coil burden plus 50 VA extra capacity.
4. Starters shall be furnished with one N.O. and two N.C. auxiliary contacts, in addition tothe seal-in contact. Auxiliary contact wiring shall be brought out to terminal strips mounted within the unit compartment.
5. Overload relays shall have one N.O. and one N.C. contact.
6. Starters Size 4 and smaller shall connect to the vertical bus with silver plated stab-on connectors. These connectors shall be constructed so as to increase contact pressure under short circuit conditions.
7. Compartments shall have steel barriers top and bottom to provide isolation between units. Unit support brackets shall be provided in the structure to properly align theunit.
8. Compartments labeled SPARE shall be equipped with a control unit of the size and type indicated on attached Drawings, and those labeled SPACE shall be equipped to receive the largest unit which can be mounted in the allotted space.
9. Unless otherwise indicated, provide each starter with HAND-OFF-AUTO selector switch and red and green pilot lights. Provide other devices and accessories as scheduled on the Drawings or otherwise required.
10. Provide with a 4” concrete housekeeping pad. Anchor each vertical section to the supporting housekeeping pad using a minimum of four (4) 1/2" expansion anchors.

1.3 Starters

A. Starters, except for those starters supplied in motor control centers, shall be supplied by the Mechanical Contractor and coordinated with the mechanical equipment. The Electrical Contractor will install and terminate the power conductors but control wire will not be in the Electrical Contractor's scope.

B. The Design Engineer shall show the physical size and location of the starters on the Electrical Drawings. The starter shall be shown to scale in order to ensure that adequate space is provided.

The location of starters will be coordinated with other equipment so that adequate space and accessibility is provided for maintenance.

C. Combination starters are permissible. They shall use magnetic-only circuit breakers. The operator handle shall not be mounted any higher than 6'-6" above the finished floor.

D. Starters shall be located within sight of the associated motor whereverpracticable.

E. Starters shall be mounted 6'-6" or lower where required for local control. If this is not practicable, then a local control station shall be provided.

F. Reduced voltage starters shall be provided for motors 50 HP and larger if motor starting causes unacceptable voltage dips. Voltage dips shall be analyzed in accordance with IEEE Std.241- 1990, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.

G. Enclosures shall be as required by the environment.

1.4 Disconnect Requirements

A. Enclosures for motor disconnect switches shall be as required by the environment.

B. Disconnect switches shall be provided for all motors in accordance with the National Electrical Code.

C. The physical location and size of all disconnect switches shall be shown on the plans and drawn to scale in order to insure proper coordination with otherequipment.

D. Fusible disconnect switches shall not be mounted higher than 6'-6" or above ceiling unless approved in writing by the Alamo Community College District.

E. Fusible disconnect switches shall be provided and indicated where they are required because of the short circuit withstand capability of the starters associated with it (i.e., where air conditioning and refrigeration equipment nameplate indicates maximum fuse size and does not indicate that circuit breakers may be used for branch circuit protection).

F. Where starters are located out of sight from the motor, then a nonfusible disconnect shall be required within sight and 50' of the motor.

1.5 Phase Failure Protection

A. A phase failure protection relay shall be provided for all motors rated 5 HP or larger.

B. Provide integral phase failure protection option on packaged HVAC equipment.

C. Provide a phase failure protection relay on motor control center main feeder overcurrent devices or main circuit breakers in lieu of a relay on each starter.

END OF SECTION 26 00 09

SECTION 26 00 11 – SECURITY SYSTEM

PART 1 - Security System

1.1 Security system one-line shall include the following:

A. Power source.

B. Building control panel or multiplex fire alarm control panel.

C. Card readers.

D. Contact devices.

E. Emergency exit switches.

F. Interface wiring required for connection to campus master fire alarm panel.

1.2 System Description

A. The security system shall be supervised, remote annunciated, low voltage with remote monitoring. This system will be installed for use during hours other than normal school hours as established by Alamo Community College District (ACCD).

B. All building entry/exit doors shall have electric door holders. The door holders will be controlled through the building fire alarm system and campus master fire alarm control panel.

C. Each building main entry/exit door shall have a card reader for entry and exit. An emergency exit switch which deactivates the door holders and sounds an alarm shall be located next to each exit.

D. Location of card readers shall be established by Alamo Community College District.

E. All access controlled handicap entrances shall be fully integrated into the building security system ensuring that while providing access to the disabled, that proper access control is maintained in both the unsecured and secured modes. The security system shall be installed to comply with Americans with Disabilities Act, Texas Accessibility Standards, and ACCD policies.

F. Remote monitoring will be at the campus police station through the campus master fire alarm panel.

G. All building and room access control systems shall be systems, equipment, and accessories compatible with the current ACCD's security system. All auxiliary accessories or supporting devices shall be fully compatible with and able to integrate with the existing campus system.

H. The security system shall be designed and noted to be installed to not interfere with the egress requirements for life safety nor interfere with intrusion or fire alarm systems.

I. All security system access control installations shall use housing and mounting designed to provide sufficient protection against tampering and vandalism. Torx center pin security fasteners shall be used on all devices installed in public areas.

J. Provide notes stating that all equipment and components to support security system shall be installed per manufacture's specifications. Installation of components and hardware shall be in place prior to connection to the access control system.

K. Provide note stating that security system shall be configured to provide a fail secure with mechanical manual egress from the secure side in the event of a loss of power, loss of network communications, or system failure.

L. Provide note stating that access control equipped doors locking hardware shall include keyed locking mechanisms accessible from the unsecured side to allow keyed manual operation of the door.

M. All security system equipment, including controllers and power supplies, shall be located in accessible and secure rooms; with telecommunications/IDF rooms being preferred.

N. All electric power supplies and power converters for the security system equipment and hardware shall be connected in the telecommunications/IDF room. Power supplies located at the access equipped door should be avoided.

O. As a minimum, provide conduit from all access devices, hardware, and equipment to ceiling location to allow for convenient access to raceway for cabling.

P. All new construction installation of the security system shall be hardwired.

Q. All delayed egress equipped doors will be monitored by the security system for device power supply status, fire alarm relay status, device arm/disarm status, device alarm status, and door position.

R. Security system power supplies should be connected to the building emergency power system to insure service in the event of AC power failure or battery failure.

S. Security system power supplies should be equipped with battery back up to insure operation in the event of power failure regardless of building emergency power supply.

1.3 Drawing floor plans shall indicate locations of the following:

A. Building control panel

B. Card readers and emergency exit switches

C. Door contacts and holders

D. Power source

1.4 Specifications

A. Building access control master panels are to be installed at each campus as part of the Infrastructure Projects.

B. Individual building projects will require interface to campus master control panels and campus master fire alarm panel.

C. Specifications are to be edited to reflect specific requirements for each project.

END OF SECTION 26 00 11

SECTION 26 00 12 – PUBLIC ADDRESS SYSTEM

Public Address System

1.1 The Alamo Community College District currently does not use a general public address system throughout its facilities. There may be requirements by users on specific projects for public address or intercommunication systems which cannot be handled by the local telephone system. Where public address or intercommunication systems are required for particular applications which cannot be handled by the local telephone system, the Design Engineer will evaluate the options available and make recommendations along with estimates of cost for review by the Project Manager and Owner at Schematic Design.

1.2 The Design Engineer should consider the following in design of any system.

A. Intercommunication/Paging One-Line - Drawings should include a one-line with the following:
   1. Power source
   2. Master station with associated equipment
   3. Speakers/outlets, etc.
   4. Microphone outlets
   5. Volume control outlets

B. Drawings should indicate locations of speakers, volume controls, microphone outlets, amplifiers, and master control panel.

C. System should have the capability for interface to the telephone system where applicable.

D. Minimum conduit size should be 3/4" for runs below 100' and 1" or larger for runs exceeding 100'.

END OF SECTION 26 00 12

SECTION 26 00 13 – LIGHTNING PROTECTION

PART 1 - Lightning Protection

1.1 The Engineer shall perform a "Risk Assessment" calculation to determine the potential for losses to a specific building due to lightning.

1.2 The calculation shall be performed in accordance with the most current edition of the NFPA National Fire Code, Chapter 780 "Lightning Protection Code" and Underwriters Laboratories Lightning Protection Code UL96-A. The basic equation for this calculation is as follows:

$$R = \frac{A + B + C + D + E}{F}$$

R = Risk Index

A = Type of Structure

B = Type of Construction

C = Relative Location

D = Topography

E = Occupancy and Contents

F = Lightning Frequency

1.3 A lightning protection should be furnished if the risk is "moderate to severe" or "severe" and should be considered if "moderate".

END OF SECTION 26 00 13

SECTION 26 00 14– UNDERGROUND PRIMARY DISTRIBUTION

PART 1 - Underground Primary Distribution

1.1 Voltage

A. The voltage utilized for St. Philip's, St. Philip's Southwest Campus, and San Antonio College is 4160 volt grounded wye.

B. The primary distribution voltage for Palo Alto is 13.2 kV grounded wye.

C. The primary distribution voltage for Northwest Vista College is 35kV grounded wye.

D. The maximum voltage drop allowed on the primary distribution systems at all three campuses shall be limited to a maximum of three percent.

1.2 Transient Voltage Surge Protection: Surge protection shall be provided at the main primary distribution switchboard. Additional surge protection shall be considered at the end of distribution circuits if necessary to protect the transformers. Transient voltages due to current limiting fuse operation may also require surge protection on each distribution transformer primary and should be considered.

1.3 Overcurrent Protection

A. Medium voltage current limiting power fuses shall be used for protection of the primary distribution system unless the coordination study indicates that other fuses should be used for proper coordination.

B. For new primary distribution feeders the Design Engineer shall make an overcurrent protection coordination study and verify that fuses will clear any ground faults on the system. Where ground faults will not be cleared by fuses in an acceptable period of time, then ground fault relays shall be provided.

C. Fault locators shall be provided on loop systems in order to expedite the location of cable faults. Retrofitting of these to existing transformers should be considered.

1.4 Grounding

A. A bare copper grounding conductor shall be installed in each duct with each set of primary distribution feeder conductors. This ground conductor shall be sized to carry the ground fault current without damage until the overcurrent protection device clears the fault. Where fuses are

used for overcurrent protection, the ground conductor shall be sized to carry the fault current for three times the fault clearing time of one fuse.

B. All splices and terminations shall be grounded.

C. The neutral at each primary service entrance shall be grounded.

D. Each and every electrical manhole shall be provided with a ground rod.

1.5 Type of Distribution

A. St. Philip's - The present distribution system is a primary selective system with a single CPS service feeder.

B. Palo Alto - The existing system at Palo Alto is a loop system with a single CPS service.

C. San Antonio College - This system is a simple radial system with two buses and a bus tie. There is only one CPS transformer with one feeder.

D. St. Philip's Southwest Campus - The present distribution system is a radial system. It is part of the Kelly USA system.

1.6 Northwest Vista College – Radial type distribution system.

1.7 Spare Capacity - The Design Engineer shall evaluate the existing distribution system to insure that there is adequate spare capacity for the planned expansion. If the spare capacity is not adequate, the Engineer shall indicate what steps need to be taken to upgrade the system. If the system is upgraded, consideration shall be given for future expansion.

1.8 Instrumentation and Metering - The existing primary distribution switchgear instrumentation shall be evaluated at all campuses. An ammeter and voltmeter shall be provided for all new feeders (incoming and outgoing) where feasible.

1.9 Transformers

A. All new transformers shall be pad mounted type with deadfront construction where feasible.

B. Mineral oil insulation shall be utilized in transformers. Transformers shall be located a minimum of 20' away from combustible surfaces and from windows and exit doors in non-combustible walls. If this clearance cannot be maintained, then the Design Consulting Engineer shall consult with the Project Manager for alternatives

C. All transformers shall be designed with 15-20 percent spare capacity over and above the known load including any future loads due to planned expansion. The transformer size shall be based upon the load calculation method described below.

D. The transformer rating shall be based upon 65 degrees C. temperature rise.

E. Transformer minimum impedance shall be based upon IEEE C57.12.26. The minimum percent impedance shall be 2.0 for transformers less than 225 KVA and less, 4.5 for 300 and 500 KVA transformers, and shall be 5.75 for transformers 750 KVA and above.

F. All transformers shall be connected delta primary and wye secondary.

G. Fusing - Bay-o-Net or drywell currently limiting fuses are preferred where available and fuses shall be sized in accordance with the ANSI Damage Curves for Transformers.

H. Group operated load break type switches shall be provided. The ampere rating shall be suitable for use anywhere in the Alamo Community College District.

I. Universal bushing wells shall be provided for separable connectors. Use 200 amp load break connectors where cable size permits and 600 amp non-load break connectors for larger cables.

J. Transformer pad sizes shall be uniform in size to accommodate the largest transformer in the system, so that if a spare transformer is provided it can be accommodated by any pad within the system.

K. Secondary Voltage: Standard secondary voltages shall be 480Y/277 for transformers 225 KVA and larger and 208Y/120 for smaller transformers. The Design Engineer may deviate from this where the nature of the load indicates that another voltage is more economical. Any deviation shall be reviewed with the Project Manager before proceeding with design.

L. Secondary overcurrent protection shall be provided at each transformer.

M. A partial one-line diagram shall be provided on each transformer secondary compartment door. The primary circuits shall be shown to the next primary switches or transformers located in both directions from the subject transformer. Each secondary circuit shall be shown to each building or structure served.

N. The Transformer color shall be Standard Munsell No. 7GY3.29/1.5 Green

1.10 Medium Voltage Cable

A. Cable ampacity shall be based upon the National Electrical Code.

B. The ampacity shall be calculated based upon a 30 degrees C. ambient.

C. Splices may be made in a manhole. Separable insulated connectors shall be utilized for terminating at transformers.

D. The primary circuit shall be installed with three conductors and a ground conductor per duct.

1.11 Duct Banks

A. All duct banks shall be installed with a minimum depth of 24" to the top of the duct and 18" to the top of the concrete encasement.

B. A minimum of 25 percent spare ducts shall be provided over and above allowances for any future plans.

C. The minimum duct size shall be 4" diameter for both primary and secondary duct banks. 2" may be used for secondary services less than or equal to 100 amperes.

D. A minimum of 12" separation shall be maintained between electrical and communication ducts in the same duct bank.

E. Power circuits shall be located in the top and side ducts of a duct bank. Installation in the center or bottom ducts of the duct bank should be avoided.

F. Duct banks shall have no bends with a less than a 25' minimum radius, except where they rise up into equipment.

G. The duct bank shall consist of Type EB PVC-90 degrees C. rated conduit with concrete encasement.

H. All ducts shall slope toward manholes with a constant pitch of not less than 4" per 100'.

I. All duct banks shall be routed along and parallel with roads wherever possible, and routed to avoid the footprint of future buildings.

J. There will be no less than two ducts in each duct bank.

K. The use of rebar in concrete duct banks shall be considered based upon geotechnical reports.

1.12 Manholes

A. Manholes shall be sized as required for the number and configuration of the cables therein. The minimum inside dimension shall be 6'-0" long by 6'-6" high by 4'-0" wide. Consideration shall be given to cable bending radiuses and sizes of splices when sizing manholes.

B. The maximum spacing for manholes shall be 600' for straight runs and 300' maximum spacing on curved sections.

C. A minimum of 6'-0" of wall space will be required for racking of spliced cables.

D. Permanent ladders shall not be installed in manholes.

E. Square manhole covers are not allowed.

F. Manhole covers shall be 32" minimum in diameter with a 30" clear opening.

G. No handholes will be allowed in the primary distribution system.

H. No more than a total of 180 degrees of total bends shall be permitted between manholes.

I. Manhole locations shall be determined so as to limit the cable pulling tension to acceptable levels.

1.13 Fire Proofing - Medium voltage cables shall be fireproofed in manholes and vaults.

1.14 Load Calculation Method for Equipment Sizing

A. Primary distribution circuits and equipment shall be sized based upon diversity factors and demand factors as indicated in the Standard Handbook for Electrical Engineers by Fink and Beatty.

B. The building load shall be based upon unit loads determined on a volt-amp per square foot basis from IEEE Standard 241 IEEE Recommended Practice for Electric Power Systems in Commercial Buildings. Other bases for unit load calculations shall be reviewed with the Project Manager and may be acceptable if approved by them.

1.15 Design Standards and Documents

A. The Design Engineer shall provide load calculations, voltage drop calculations, short circuit calculations and protective device coordination studies for the primary distribution system. The Contract Drawings shall include one-line diagrams, site plans, details and profiles of the duct bank system.

B. All exterior electrical features shall be identified and sized on exterior plans.

END OF SECTION 26 00 14

SECTION 26 00 15 – UNDERGROUND COMMUNICATION DUCT BANKS

PART 1 - Underground Communication Duct Banks

1.1 St. Philip's

A. Extensions of the existing main communications ductbanks shall consist of four 4" conduits.

B. Service extensions to new buildings shall consist of a minimum of four 4" conduits. The Consulting Engineer shall provide more if required.

C. The minimum service size for conduits shall be 4".

1.2 San Antonio College

A. The existing communications systems are routed through the existing utility tunnel. All new communications systems to new buildings shall utilize the existing tunnel as far as practicable.

B. Where a new main communications ductbank is required to serve two or more major buildings, provide a minimum of four 4" ducts extending from the existing utility tunnel.

C. Service extensions to new buildings shall consist of a minimum of four 4" conduits. The Design Engineer shall provide more if required.

1.3 Palo Alto

A. The existing communications ductbank consists of two 4" and three 2" conduits looped from building to building. Where the communication ductbank system must be extended from the existing buildings, utilize the two 4" and three 2" conduits stubbed out from the existing buildings.

B. All new main communications ductbanks shall consist of four 4" conduits. Building services shall be tapped from this ductbank at strategically located manholes.

C. Service extensions to new buildings shall consist of a minimum of four 4" conduits. The Design Engineer shall provide more if required.

1.4 Northwest Vista College

A. All new main communications ductbanks shall consist of four 4" conduits. Building services shall be tapped from this ductbank at strategically located manholes.

Service extensions to new buildings shall consist of a minimum of four 4" conduits. The Design Engineer shall provide more if required.

END OF SECTION 26 00 15

SECTION 26 00 16 – PRE-BID ELECTRICAL EQUIPMENT

PART 1 - Pre-Bid Electrical Equipment

1.1 Some electrical items may be pre-bid during the Design Development and Construction Document stages in order to:

A. Take advantage of competitive pricing levels associated with large quantity bidding.

B. Standardize on common items.

1.2 Following is a list of some of the typical electrical equipment which may be pre-bid:

A. Light fixtures

B. Switchgear

1.3 Fire Alarm and Detection System

1.4 Pre-bidding will be done based on the Schematic Design Drawings. Therefore, it is imperative that the Design Engineer produce Schematic Design Drawings with enough detail and accuracy for the Coordinating Engineer to arrive at meaningful quantities and capacities for pre-bidding.

1.5 Once the pre-bid items have been finalized, the Coordinating Engineer will furnish the Design Engineer with the necessary pre-bid information. Pre-bid electrical equipment will be included by the Design Engineer in his Contract Drawings, along with the cost to be included by the Contractor for each item.

END OF SECTION 26 00 16

SECTION 26 05 13 – MEDIUM VOLTAGE CABLES

PART 1 - Reference Standards

1.1 ASTM B-496, ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8 and UL 1072.

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Part 2 Products

2.1 Manufacturer

A. The Okonite Company

B. Southwire

C. Houston Wire & Cable Company

D. General Cable

2.2 Cable

A. 5kV and 15kV Shielded Power Cable

B. Annealed, Uncoated, Stranded, Single Copper Conductor

C. Type MV-90 for 5kV cables, Type MV-105 for 15kV cables

D. 15kV cable shall have 220mils, 133% Insulation factor

E. Ethylene-Propylene Rubber (EPR) Insulation

F. Shielded Copper Tape

G. PVC Jacket

2.3 Splices

A. Cold Shrink Inline Splice Kit equal to 3M 5550 Series for 5kV Cables.

B. Cold Shrink Inline Splice Kit equal to 3M 5513A, 5514A, 5515A and 5516A for 15kV Cables.

2.4 Terminations

A. Silicone Rubber Termination Kit equal to 3M 7620-T and 7690-T Series for indoor applications.

B. Silicone Rubber Termination Kit equal to 3M 7620-S, 7680-S and 7690-S Series for outdoor applications.

2.5 Design Execution

A. Service tap(s) extend from the source connection in the manhole to the line side of the fused disconnecting means or switch. The cable and means of protection beyond the switch shall be sized per building service.

B. All cable ends shall be sealed to prevent the entrance of moisture into the insulation during shipment, storage, and installation.

C. Field testing of cables is to be performed and copies of the test results provided to the owner's representative. Only qualified personnel shall do cable terminations. At each termination point, bond all shields, ground conductor, etc., to a ground rod and equipment ground system.

D. Arrange cables in manholes to permit subsequent installation of future cables in spare ducts and to permit repair and/or replacement of adjacent cables.
   1. All cables shall be identified, at the point of entry into manholes or electrical equipment, with tape to match color coding in campus standards. Cables that pass-through manholes or pull boxes without terminations shall be identified with same.
   2. All cables in manholes shall be fire taped.
   3. Route cables around the walls of the vaults.
   4. Allow for spare taps in vaults.

END OF SECTION 26 05 13

SECTION 26 05 19 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - General

1.1 ASTM B-3, B-8; UL 44, 62, 83, 758, 1063, VW-1; IEEE 383; Fed. Spec. CID A-A-55543; ICEA S-95-658; NEC 300, 310.

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. Southwire

B. Houston Wire & Cable Company

C. Essex

D. General Cable

2.2 Cable

A. 600V Insulation Class

B. Insulation Types: XHHW, THHN/THWN.

C. Temperature Rating: 75ºC, 90ºC.

D. All conductors, plus stranded, shall be soft drawn annealed copper, ninety-eight (98%) conductivity, continuous, from outlet to outlet.

E. Minimum size of branch circuiting wire shall be #10 AWG.

F. With the exception of light fixture tails where both ends of the metallic cable can be accessed for replacement, metallic sheathed cable, MC or BX cable is prohibited.

G. Shall be permanently marked every 2-feet to indicate conductor size, voltage class, insulation type and temperature rating.

H. Shall be stranded conductor for all wire sizes.

PART 3 - Execution

3.1 Design Execution

A. All branch circuit home runs shall contain no more than two multi-wire branch circuits. Multi-wire branch circuits shall not be used where the load generates harmonics, i.e. personnel computers. ALL circuits serving personnel computers shall contain its own dedicated neutral conductor.

B. All branch circuiting homeruns shall be clearly indicated on electrical construction documents.

3.2 Installation

A. Install in approved raceway system.

B. Handle and install to ensure that maximum tensile and compressive strengths of conductor and insulation are not exceeded and that the conductors are not kinked or the insulation damaged.

C. Wire pulling lubricant: UL listed products recommended or specified by the wire and cable manufacturers with which the lubricant is utilized. The use of soap flakes, liquid detergents, or vegetable oils is unacceptable.

D. Install line and load side conductors of feeders and branch circuits in separate conduits, except that lighting switch legs may be installed in the same conduit with branching wiring.

E. Do not install feeder and branch circuit conductors in the same conduit.

F. Insulation color coding shall be consistent with the City of San Antonio's amendments to the NEC-Chapter 10.

G. Service entrance conductors shall be type XHHW.

H. General building wiring shall be type THHN/THWN.

I. Crimp connectors and splices shall only be used in J-boxes, gutters, and cabinets.
1. A compression connector installation tool such as Panduit CT-720 or a compound-action crimping tool such as a VACO T1710 that provides a crimp that meets or exceeds MIL-SPEC pull-out tests shall be used for all such connections.

2. Crimps shall be made on each wire end of the connector for as much of the length of the barrel as possible.
3. The longest barrel/sleeve possible shall be used.
4. Crimp connectors shall not be used on items that may need to be changed out periodically, i.e.: ballast's, motors, etc.

J. All connectors shall be copper or tinned copper.

K. Voltage Drop.
1. Voltage drop shall be considered for all feeders and long branch circuits and calculations made where any concern exists.
2. The maximum demand load voltage drop shall be 5%.
3. Starting motor voltage drop shall be considered for large motors. Where the starting of large motors would create excessive voltage drops at lighting or secondary building power panelboards, reduced voltage or other types of starters shall be employed.

3.3 Testing

A. Shall comply with the International Electrical Testing Association, Inc. (NETA) and the Institute of Electrical and Electronics Engineers, Inc. (IEEE) acceptance testing specifications for low voltage cable.

END OF SECTION 26 05 19

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - General

1.1 Reference Standards

1.2 Raceways;

A. ANSI C80.1, C80.3, ANSI/NEMA FB 1, NFPA 70, NECA, NEMA TC 2 and 3, UL 1, 6, 360, 514B, 797, and 1242.

1.3 Boxes;

A. NFPA 70, UL 50, 514A, 870 and 886.

1.4 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer
(See below)

2.2 Raceways

A. Rigid Metal Conduit (RMC), Intermediate Metal Conduit (IMC) and Electrical Metallic Tubing (EMT)
1. Allied Tube & Conduit
2. Wheatland Tube Company
3. Western Tube & Conduit Corporation

B. Flexible Metal Conduit (FMC) and Liquid Tight Flexible Metal Conduit (LFMC)
1. American Flexible Conduit
2. Anamet, Inc.
3. Electri-Flex Company
4. International Metal Hose

C. Rigid Nonmetallic Conduit (RNC)
   1. Carlon
   2. Cantex

D. Boxes
   1. Appleton Electric
   2. Hubbell-Raco
   3. Thomas & Betts-Steel City
   4. Cooper Crouse-Hinds
   5.

PART 3 - Execution

3.1 Installation

A. Install raceways in compliance with the requirements of NEC and these specifications.
   1. Rigid Metal Conduit (RMC) and Intermediate Metal Conduit (IMC):
      a. Provide in mechanical equipment rooms to a height of 60" above finished floor, for service entrance conduits, feeder conduits**,** in damp or wet locations, in under-floor crawl spaces, where exposed to physical damage, and for conduits installed underground, except as herein otherwise allowed.
   2. Electrical Metallic Tubing (EMT):
      a. May be installed:
         1) Concealed above grade.
         2) Where exposed 60" above finished floor in mechanical rooms.
      b. Shall not be installed:
         1) For feeder conduits.
         2) Underground.
         3) In ground bearing concrete slabs.
         4) In hazardous, classified locations.
         5) In areas where subject to physical damage.
         6) In damp or wet locations.
         7) In under floor crawl spaces.
   3. Rigid Nonmetallic Conduit:
      a. May be installed for underground branch circuit and feeder conduits from a point 5'-0" outside the building line to the load served. Provide RMC elbows at transition from underground to above grade.
      b. May be installed under building slab on grade [when encased in a 3" thick envelope of 2500 psi concrete]. Where passing through beams or footings, provide rigid metal conduit to extend 5'-0" either side thereof. Where passing below grade beams, install minimum of 12" below bottom of beam.
      c. Shall not be installed concealed or exposed within the building.

d. In sizes 2” and larger and supported at not less than 72" on center, may be installed within under floor crawl spaces provided that the crawl spaces are not utilized as air handling plenums or as a source of outside air supply for environmental HVAC systems or process air systems.

e. Below grade installation: Minimum trade size permitted for below grade installation, 1” diameter. Make joints watertight. Install couplings, connectors, and elbows using approved adhesive, driving joint tight and ensure permanent adhesive set prior to backfill or conductor installation conductors.

4. Flexible and Liquid Tight Metal Conduit:

a. Provide from point of connection to rotating, reciprocating and vibration producing equipment and machines, to the point of connection with the rigidly supported conduit wiring system. Minimum length; 24" or 12" per 1" of conduit diameter, whichever is greater.

b. May be installed in lengths to 72" maximum to connect recessed lighting fixtures installed in accessible ceilings to the branch circuit wiring system.

c. Provide liquid tight PVC jacket and terminate using UL listed liquid tight fittings where installed in damp and wet locations and in locations subject to airborne oil, grease, exhaust fumes, or similar contaminants.

d. May be installed in dry locations where conditions preclude the installation of rigid conduit systems, or to span expansion joints by connecting between pull boxes located either side of the joint. Provide in sufficient length to compensate for joint movement.

e. In sizes 1/2", 3/4" and 1". May be installed concealed in dry wall construction and above accessible ceilings, in lengths not exceeding 10 feet. It is the intent of this paragraph to permit flexible conduit to be utilized, in lieu of EMT, for the installation of branch circuit wiring from outlet box to outlet box.

5. Conduit Installation: Conceal conduit within walls, ceilings, plenums, and chases. Where installed exposed in other than mechanical and electrical rooms, obtain the approval by the Architect prior to installation. DO NOT INSTALL CONDUITS CONTAINING FEEDERS OR BRANCH CIRCUITS IN GROUND BEARING OR STRUCTURAL CONCRETE SLABS OR IN CONCRETE STRUCTURAL MEMBERS. EXCEPTION: LIGHTNING PROTECTION DOWN CONDUCTORS AND AS SPECIFICALLY NOTED HEREIN OR WITHIN THE CONSTRUCTION DRAWINGS.

a. Minimum Acceptable Conduit trade size: 3/4" diameter except that 1/2" C is acceptable for switch legs and for branch circuit taps to lay in type lighting fixtures.

b. Do not install in the horizontal above or below in parallel with steam, water, or waste piping. Maintain parallel runs a minimum of 6" from steam and hot water piping, and a minimum of 24" from boiler flues or exhaust stacks.

c. Install parallel with or at right angles to building lines, structural members, ceiling members, and walls where located above accessible ceilings or where visible after completion of project. In underfloor crawl spaces, routing may be direct reckoning.

d. Make changes of direction using field bends, factory elbows, UL listed conduits bodies, or appropriately sized junction or pull boxes. Make field-bends and offsets using proper conduit hickeys, hand benders, or mechanical benders.

e. Provide pull boxes to limit the number of equivalent 90-degree bends in any conduit run to three (3).
f. Install conduits passing through fire rated partitions, walls, and floors in a manner so as to maintain the specified and required fire rating. Seal openings and annular spaces of pipe sleeves with UL listed component materials. Acceptable manufacturers: 3M, General Electric and Dow. Provide, for conduits penetrating fire rated floor structures and serving pedestal or surface mounted power outlets, wiring devices, or communications outlets, UL listed assemblies as specified above.
g. Terminate threaded conduits in unthreaded openings of metallic and nonmetallic boxes and cabinets using two locknuts and nonmetallic insulating bushings or with one locknut and one insulated throat malleable iron or steel bushing. Zinc die cast metallic bushings are not acceptable.
h. Terminate unthreaded conduits of 1/2” and 3/4" in unthreaded openings of metallic and nonmetallic boxes and cabinets using conduit connector fittings. Provide insulated throat connector fittings for conduits 1" and larger. Provide insulated throat metal grounding bushings at termination point of metallic service entrance conduits.
i. Prevent concrete, plaster, dirt, trash, or other foreign materials from entering or lodging in conduit systems and equipment during construction.
j. Provide pull wire in empty conduit systems.
k. Field Cutting and Threading: Cut conduit ends square, thread using proper hand or power machines, ream and leave cut ends free of burrs and jagged edges. Paint threads with Thomas and Betts "KOPR-SHIELD" compound. Paint exposed threads with a cold galvanizing compound.
l. Conduit systems shall be complete and electrically continuous before conductors are installed.
m. Provide insulated bushings for conduits terminating or stubbing-out into plenums, chases, raised floors, and communications equipment rooms where wiring method changes from wiring in raceway to open wiring.
n. Spare Conduits: Provide a minimum of three (3) 3/4" conduits from each flush mounted panelboard to an accessible ceiling location.
o. Conduit shall not be mounted in or on the floor. In place of floor boxes, conduit shall be roughed in below the floor and installed by core drilling the floor after final placement is approved.

6. Conduit Support:
a. Provide, for each conduit type, supports at intervals in accordance with NEC-1999, Articles 345 through 351. Support conduit by means of pipe straps, wall brackets, hangers, or trapeze assemblies. The load applied to fasteners, anchors and trapeze assemblies shall not exceed 25% of the maximum rated working load. For pipe strap installations on conduit sizes one inch and larger provide two-hole type pipe straps. The use of perforated strap iron is unacceptable.
b. Fasten to wood surfaces using wood screws; to hollow masonry units using toggle bolts; to concrete and brick surfaces using lead inserts or expansion bolts; to metal, lumber, and steel work using machine screws or spring tension clamps. Use insert

anchors in poured-in-place concrete construction. Threaded C-clamps may be used only on rigid conduit. Do not weld pipe straps or conduits to structural steel members.

c. Multiple conduits, installed in parallel may be supported by means of trapeze assemblies fabricated of minimum 3/8" diameter galvanized all-thread rods and galvanized channel, Unistrut P1000 or equal, assembled and supported by inserts, beam clamps, bolts, flat washers, lock washers, and hex nuts. Fasten conduits to the first, last, and alternate trapeze assemblies by means of two hole straps or u-bolt clamps. Load trapeze assemblies to not greater than 1/4 (25%) of the rated load capacity.

d. Do not support branch circuit conduit systems utilizing suspended ceiling supporting systems.

e. Support vertical risers by U-clamp hangers at each floor level and at intervals not exceeding 10'-0".

f. Support flexible metal conduit at intervals not exceeding 36" on center and within 12" of each termination in a junction or pull box, conduit fitting, or cabinet.

g. Sleeves and Inserts: Layout in advance of the construction of structural members, walls, floors, and roof decks and install in the proper sequence of work. Sleeves shall be as specified in Section 16010, "General Requirements for Electrical Work".

h. Coordination: Prior to rough-in, coordinate the work of this section with that of other divisions and sections to avoid conflicts of space utilization.

7. Underground Conduits:

a. Excavation and Backfill:

1) Excavate along straight lines to the width and depth required for proper installation of conduits. Where excavated below the necessary elevation, backfill with sand and compact to the proper elevation.

2) Where rocks, materials with sharp edges, permanently moist, or unstable ground is encountered, excavate to a depth 4" below the specified elevation, and backfill with 4" of sand, free of particles that would be retained by a 1/4" sieve.

3) Dewater trenches before installing conduit.

4) Backfill in not more than 6" lifts, compacted to 95% of the density of adjacent soil, with soil materials free of rocks, debris, roots, wood, scrap materials, or vegetable matter.

5) Where necessary to remove sod, remove in large sections and carefully set aside and care for until replaced. Backfill the top 4" of trench with topsoil before replacing sod. Carefully replace sod and water thoroughly. If dead or severely damaged, replace with like material or seed as directed by the Architect.

6) Underground Conduits Without Concrete Encasement:

a) Install to code required depth, but not less than 24", below finished grade or as detailed in the drawings and at a minimum slope of 3" per 100' away from buildings.

b) Following backfill and prior to conductor installation, clean each conduit using a testing mandrel not less than 12" long with a diameter 1/4" less than the inside diameter of the conduit. Pull through the conduit followed by a brush having stiff bristles, until the conduit is clear of all particles of earth, sand, gravel and other contaminates.

7) Underground Conduits, Concrete Encased:
   a) Provide concrete encasement of conduits extending below slab on grade, below paved areas, roadways, driveways and parking areas.
   b) Concrete encasements shall be steel reinforced.
   c) Extend concrete encasement to a minimum of five (5) feet beyond the edges of paved areas, driveways and roads. Conduits installed under existing paved areas, which are not to be disturbed, shall be rigid metal conduit (RMC) and jacked into place.
   d) Provide base and intermediate spacers to allow a minimum of 3" of encasement on all sides and a minimum of 2" between parallel runs.
   e) Following backfill and prior to conductor installation clean each conduit using a testing mandrel not less than 12" long with a diameter 1/4" less than the inside diameter of the conduit. Pull through the conduit followed by a brush having stiff bristles until the conduit is clear of all particles of earth, sand, gravel and other contaminants.
   f) Concrete - Class B, 2500 psi, maximum aggregate size of 3/4", slump test of 3" to 4".

b. Provide O.Z./Gedney Type "CSBI" conduit sealing bushings where service entrance conduits enter service equipment.

c. Underground conduits shall be observed and accepted by the Owner's Representative before backfill or encasement. Notify the Owner's representative a minimum of 48 hours before an observation is required.

d. Provide duct line marking tape 12" below finished grade over all underground power and communications service entrance conduits.

8. The minimum bend radius for underground service and feeder conduit shall be 36" except at vertical risers to equipment.

9. Wall Penetrations Below Grade:
   a. Where conduits enter an interior building space through concrete construction from below finished grade, provide the following construction for each conduit:
      1) Poured-in-place water stop steel sleeve, equal to Link Seal Model AWS@.
      2) Seal annular space between conduit and sleeve using Link Seal Type LS Model C sealing assemblies, O.Z./Gedney series CSM sealing fittings or acceptable equivalent.
      3) Terminate conduit in junction or pull box and provide sealing bushings, O.Z./Gedney series CSBI, at cable exit from conduit into box.

B. Install raceways in compliance with the requirements of NEC.
   1. Boxes, Outlets and Supports: Provide boxes in the raceway system where required for pulling conductors, making connections, and mounting devices and fixtures.

a. Provide boxes of the volume required by NEC for the number and size of conductors installed. The use of box extension rings to increase box volume for the purpose of increasing the quantity of conductors permitted by Article 370 is not acceptable.

b. Provide minimum 2-1/8" deep except where shallower boxes are required due to structural conditions are approved. Provide accessories as required for the intended function at each box, including mounting hardware, hangers, extension rings, fixture studs and covers.

c. Provide cast metal hub type within damp and wet locations, where surface mounted outside. Within dry locations, provide boxes of zinc galvanized steel. Provide gaskets for cast metal boxes installed in wet locations and for boxes installed flush with the outside of exterior walls. Provide knockout closures or plugs in unused openings.

d. Boxes for other than lighting fixture outlets and data/telecom outlets: Minimum 4" square by 2-1/8" deep.

e. In masonry, block and tile walls provide square cornered masonry boxes or standard boxes fitted with square cornered tile rings.

f. Boxes for surface mounted lighting fixtures - minimum 4" square or octagonal.

g. Boxes for ganged devices: 4" square for two devices and solid ganged boxes for more than two devices.

h. Boxes for switches and receptacle outlets: 4" square and fitted with plaster or tile device rings appropriate to the installed location, conditions and wall construction and the quantity and type of devices contained.

i. Boxes for data/telecom outlets: 4" square, extra deep, and fitted with a single gang opening plaster or tile device rings appropriate to the installed location, conditions and wall construction and the quantity and type of devices contained.

j. Thru-wall boxes and back-to-back installation are not acceptable. Provide minimum 6" horizontal or vertical separation of boxes installed on a non-rated common wall or partition. Provide 12” horizontal or vertical separation in fire-rated partitions. Provide minimum 24" separation in acoustical rated walls.

k. Supports:

   1) Support boxes and pendants for surface mounted fixtures independent of suspended ceiling supports, or make adequate provisions for distributing the load over the ceiling supporting members using a minimum of two approved bar hangers or 1-1/2" lathers channels spanning the horizontal ceiling suspension members.

   2) Fasten boxes and supports with wood screws to wood, with expansion bolts or metallic (lead) anchors on concrete and brick, with toggle bolts on hollow masonry units and gypsum board, and with machine screws on steel work. Plastic anchors are not acceptable.

   3) In light weight metal stud construction, support boxes using Caddy Fasteners series “SGB” screw gun brackets, series “H” box mounting brackets or series “RBS” box mounting brackets.

   4) Do not utilize outlet boxes to support fixtures or loads of 25 lbs. or greater, or for supporting ceiling fans. Support fixtures and loads greater than 25 lbs. and ceiling fans from building structure, independent of the associated outlet box,

raceway and ceiling suspension system, except where the box is specifically designed for the application.

5) Support cast metal boxes by means of integral mounting lugs or by the raceway system in which installed. Drilling of cast boxes is not acceptable.

l. Locations of Outlets:

1) Carefully layout the location and elevation of each box and coordinating with architectural appurtenances, millwork, casework and furniture. Examine the architectural documents to ensure that outlet locations and elevations agree with provided details. Architectural details of box and outlet locations have precedent.

2) Install boxes in manner to ensure that the equipment or piping of other trades passing under, over, across, or in close proximity to will not cause the box to be inaccessible for use or maintenance.

m. Mounting Heights: Unless otherwise noted in the drawings, mounting heights for box mounted devices shall be as listed below.

OUTLET MOUNTING HEIGHT	
Wall Switches	48" (to top of box)
* Receptacles	15" (to bottom of box)
Toggle Switches	48" (to top of box)
Desk Telephone Outlets	15" (to bottom of box)
** Wall Telephone Outlets	48" (to top of box)
Disconnect Switches	66" (maximum)
Clock Outlets	90" (to top of box)
Fire Alarm Notification Appliances	80” (to bottom of box)
Fire Alarm Manual Pull Stations	48" (to top of box)
Alarm Bells	84" (to bottom of box)
Wall Speaker Outlets	90" (to top of box)

OUTLET MOUNTING HEIGHT	
Push-button Stations	48" (to top of box)
Emergency Lighting Units	96" or 6" below ceiling
Wall Mounted Light Fixtures	78" or as specified
* A.C. - above counter tops (6" normally). Verify exact mounting heights required with architectural details. Mount in horizontal orientation.	
** Wall mounted public telephones, handicap accessible - 36"	

n. Provide blank covers for boxes that are not covered by device plates or lighting fixtures.
o. In dry locations, provide 1/2" raised galvanized device covers for surface mounted boxes.
p. Install boxes so that device covers are plumb and tight against the wall finish.
q. Center wall bracket outlets on columns and above doors where indicted at these locations.
r. In noncombustible walls and ceilings, install recessed boxes with front edge set back not more than 1/4" from the finished surface. In combustible construction, install with front edge flush with finished wall or ceiling surface.
s. In plaster, drywall, or plasterboard surfaces, gaps or open spaces at the edge of the box or fitting greater than 1/8" are not permitted.
t. All meatal, flexible conduits shall be steel.
u. Metal conduit fittings shall be steel or cast iron.
v. All exterior J-boxes used in earth, concrete or asphalt shall be traffic rated. These boxes shall be installed so that the top surface is at, or above grade with grade sloped up to them. Boxes should be installed so that they are not in a drain channel or “low spot”.

END OF SECTION 26 05 33

SECTION 26 05 36 – CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - General

1.1 Reference Standards

A. ASTM A123, A510, A569, A570, A653/653M, B633; NEMA-VE 1, VE 2; NEC 392

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. GS Metals

B. Cablofil, Inc.

C. Mono-Systems, Inc.

D. Wiremold

2.2 Material

A. Welded wire mesh cable management system produced from high mechanical strength steel wire, welded into a 2”x4” net, then formed into channels to carry cables.

B. Minimum wire diameter: 0.197-inches

C. Maximum straight section lengths: 120-inches.

D. Minimum tray width: 24-inches.

E. Minimum tray loading depth: 4-inches.

F. Epoxy powder coat finish complying with ASA 61 grey.

PART 3 - Execution

3.1 Installation

A. Shall be used as a cable management system for telecommunication and signal wiring only.

B. Support cable tray not more than 8-feet on center and at each bend and tee transition.

C. Support, as recommended by the manufacturer for the specified class, on trapeze/center style hangers with minimum 1/2" galvanized threaded rod hangers from preset concrete inserts or other approved support brackets as required to support the cable management system.

D. Connect sections of cable tray together with edges free from burrs and sharp projections.

E. Install a grounding strap between sections to insure electrical continuity.

END OF SECTION 26 05 36

SECTION 26 05 43– UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - General

1.1 Reference Standards

A. UL6, 514B, 651, 651A, 1242.

B. NEC.

C. NEMA.

D. ANSI.

E. ICEA.

F. IEEE.

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

2.2 Raceways

A. Rigid Metal Conduit (RMC) and Intermediate Metal Conduit (IMC)
   1. Allied Tube & Conduit
   2. Wheatland Tube Company
   3. Western Tube & Conduit Corporation

B. Rigid Nonmetallic Conduit (RNC)
   1. Carlon
   2. Cantex

PART 3 - Execution

3.1 Installation

A. Concrete encased ductbank shall be constructed of steel reinforced, 2500 psi rated concrete with red dye as specified and detailed in the drawing.

B. Concrete encased ductbank shall be buried with a minimum of 36 inches of cover from finished grade.

C. Conduits encased in ductbanks shall be PVC schedule-40 for straight runs. RMC or IMC shall be used for 90-degree bends, offsets, and for the first 10-feet section from manholes.

D. Tracer wire shall be installed at 24” below finished grade.

E. Provide nonmetallic conduit spacers between each vertical and horizontal layer and row of conduits at no greater than 4 feet on center.

F. Number and size of ducts shall be indicated on drawings.

G. Ducts shall be kept clean of concrete, dirt, or foreign substances during construction.

H. Cable pulling through ductbanks shall not exceed the maximum pulling tension and side wall pressures recommended by the cable manufacture.

I. Upon prior approval from the Alamo Community College District, nonmetallic schedule-80 conduit may be direct buried.

END OF SECTION 26 05 43

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - General

1.1 Reference Standards

A. ANSI Standard A13.1

B. NFPA 70

C. NEMA

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. American Label Mark

B. Calpico

C. Cole-Flex Corp.

D. Emed Co., Inc.

E. George-Ingraham Corp.

F. Markal Corp.

G. Panduit Corp.

H. W. H. Brady & Co.

I. 3M Scotch Code.

2.2 General

A. Provide nameplate identification for switchboards, panelboards, transformers, control panels, starters, controllers, and other significant equipment. Designations shall match those indicated on drawings.

B. Provide manufacturer's standard products of categories and types required for each application unless otherwise indicated. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

C. Adhesive Marking Labels for Raceway and Metal-Clad Cable: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Light, Power dc, Air Conditioning, Communications, Control, Fire).

D. Provide pre-tensioned bands, snap-around, colored plastic sleeves, colored adhesive marking tape, or a combination of the two for conduit requiring identification. Bands shall be not less than 2" wide, completely encircling conduit, and place adjacent bands of two color markings in contact, side by side. Bands shall be installed at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs.

E. Identify Junction, Pull, and Connection Boxes

F. Underground Electrical Line Identification

G. Install line marker for underground wiring, both direct buried and in raceway.

H. Provide wire/cable designation tape markers

I. Provide aluminum, wraparound, cable marker bands

J. Baked-Enamel warning and caution signs for interior use.

K. Metal-Backed, butyrate warning and caution signs for exterior use.

L. Cable-ties shall be fungus-inert, self-extinguishing, one-piece, and self-locking. Provide cable ties in specified colors when used for color-coding.

PART 3 - Execution

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC and applicable ANSI standards.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Conduit Identification: Identify high-voltage feeder conduits (over 600V) by words "DANGER-HIGH VOLTAGE – VOLTS" in black letters 2" high, stenciled at 10 foot intervals over continuous painted orange background.

E. The following areas shall be identified:
1. On entire floor area directly above conduits running beneath and within 12" of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
2. On wall surfaces directly external to conduits run concealed within wall.
3. On accessible surfaces of concrete envelope around conduits in vertical shafts, exposed at ceilings or concealed above suspended ceilings.
4. On entire exposed conduits surface.

F. Apply identification to areas as follows:
1. Clean surface of dust, loose material, and oily films before painting.
2. Prime Surfaces: For galvanized metal, use single-component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic resin block filler. For concrete surfaces, use clear alkali-resistant alkyd binder-type sealer.
3. Apply one intermediate and one finish coat of orange silicone alkyd enamel.
4. Apply primer and finish materials in accordance with manufacturer's instructions.

G. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around, colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2" wide, completely encircling conduit, and place adjacent bands of two color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40 foot maximum intervals in straight runs. Apply the following colors:
1. Fire Alarm System: Red.
2. Fire Suppression Supervisory and Control System: Red and Yellow.
3. Combined Fire Alarm and Watchmen's Report System: Red and Blue.
4. Watchmen's Report System: Blue.
5. Security System: Blue and Yellow.
6. Civil Defense System: Yellow.
7. Clock System: Green.
8. Mechanical and Electrical Supervisory System: Green and Blue.
9. Telephone System: Green and Yellow.

H. Identify Junction, Pull, and Connection Boxes: Code required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange

background. Install on outside of box cover. Also, label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

I. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16"; install a single line marker.

J. Install line marker for underground wiring, both direct buried and in raceway.

K. Conductor Color Coding:

1. Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208/120 VOLTS	**PHASE**	**480/277 VOLTS**
Black	A	Purple
Red	B	Brown
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

L. Use conductors with color factory applied the entire length of the conductors except as follows:

1. The following field applied color coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG. Apply colored, pressure-sensitive plastic tape in half- lapped turns for a distance of 6" from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1" wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration. Conductors #10 and smaller, color code by means of factory applied, color impregnated insulation. Conductors #8 and larger, color code by means of plastic coated self-sticking markers, colored nylon cable ties, or heat shrink type sleeves, or colored vinyl tape.

2. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3" from the terminal and spaced 3" apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

M. Power Circuit Identification: Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pullboxes, junction boxes, manholes, and switchboard rooms with 1/4" steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb. test monofilament line or one-piece self-locking nylon cable ties.

N. Tag or label conductors as follows:
1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
2. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three-circuit, four-wire homeruns), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and communications/signal wiring, use color-coding or wire/cable marking tape at terminations and at intermediate location where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
3. Match identification markings with designations used in panelboard Shop Drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

O. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by NEC, by ANSI, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Locations shall include but not be limited to the following:
   a. Electrical room doors.
   b. Electrical equipment rated over 600V.
   c. Opened doors and enclosures exposing electrically energized parts.

P. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

Q. Emergency Operation Signs: Install engraved laminate signs with white legend on red background with minimum 3/8" high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

R. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm system, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2" high letter on 1-1/2" high label (2" high where two lines are required), white lettering in black field. Text shall match terminology and number of the Contract Documents and Shop Drawings. Apply labels for each unit of the following categories of electrical equipment:

    a. Panelboards, electrical cabinets, and enclosures.
    b. Access doors and panels for concealed electrical items.
    c. Electrical switchgear and switchboards.
    d. Motor control centers.
    e. Motor starters.
    f. Pushbutton stations.
    g. Power transfer equipment.
    h. Contactors.
    i. Remote controlled switches.
    j. Dimmers.
    k. Control devices.
    l. Transformers.
    m. Power generating units.
    n. Telephone switching equipment.
    o. Clock/program master equipment.
    p. Call system master station.
    q. TV/audio monitoring master station.
    r. Fire alarm master station or control panel.
    s. Security monitoring master station or control panel.

S. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

T. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 26 05 53

SECTION 26 05 73 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - General & Execution

1.1 Coordination Study

A. All distribution and branch circuit feeder overcurrent protective devices immediately serving the fualt shall be selected so that they will clear or trip prior any next level, upsteam overcurrent protective devices. Careful study of all main feeder and branch feeder overcurrent protective device trip characteristics is required.

B. Coordinated Power System Protection: Analysis shall be prepared to demonstrate that equipment selected and system constructed meet contract requirements for ratings, coordination, and protection. They shall include fault current analysis, and protective device coordination study. Studies shall be performed by licensed professional engineers with demonstrated experience in power system coordination in last three years.

C. Scope of Analysis: Fault current analysis and protective device coordination study shall begin at source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600-volt level distribution buses or panelboards.

D. Equipment Data: Time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Contractor shall coordinate with commercial power company for fault current availability at site. Installing electrical contractor shall provide feeder lengths, conduit types and other information as required.

E. Single Line Diagram: Single line diagram shall be prepared to show electrical system buses, devices, transformation points, and sources of fault current. Each bus, device or transformation point shall have unique identifier. Location of switches, breakers, and circuit interrupting devices shall be shown on diagram together with available fault data, and device interrupting rating.

F. Fault Current Analysis:
   1. Method: Fault current analysis shall be performed in accordance with methods described in IEEE Std. 242, and IEEE Std 399.
   2. Data: Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those installed. Data shall be documented in report.

G. Fault Current Availability: Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. Maximum values of fault current available at each location shall be shown in tabular form on diagram or in report.

H. Coordination Study: Study shall demonstrate that maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. Study shall include description of coordination of protective devices in this project. Written narrative shall be provided describing: which devices may operate in event of fault at each bus; logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (analysis of device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability shall be provided. Composite coordination plots shall be provided on log-log graph paper.

I. Study Report:
   1. Report shall include narrative describing: analyses performed; bases and methods used; desired methods of coordinated protection of power system.

J. Report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.

K. Report shall contain fully coordinated composite time-current characteristics curves for each bus in system, as required to ensure coordinated power system protection between protective devices or equipment. Report shall include recommended ratings and settings of protective devices in tabulated form.

L. Report shall provide calculation performed for analyses, including computer analysis programs utilized. Name of software package, developer, and version number shall be provided.

END OF SECTION 26 05 73

SECTION 26 12 00 – MEDIUM-VOLTAGE TRANFORMERS

PART 1 - General

1.1 Reference Standards

A. Liquid-Filled: IEEE C57.12.00, C57.12.90, C57.13; ANSI C37.47, C57.12.26, C57.12.28; ANSI/IEEE 386; ASTM Dry-Type: ANSI C37.121, C57.12.28, C57.12.50, C57.12.51, C57.12.55, C57.12.70; IEEE C57.12.01, C57.12.56, C57.12.58, C57.12.59, C57.12.80, C57.12.91,

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. Square D

B. Culter-Hammer

C. General Electric

D. Siemens

E. ABB

2.2 Liquid-filled Transformers

A. Compartment type, self-cooled for mounting on a steel-reinforced, concrete pad.

B. Enclosure shall be suited for outdoor installation.

C. Average temperature rise of the windings, measured by the resistance method, shall be 65ºC. when the transformer is operated at rated kVA output in a 40ºC. ambient.

D. Coolant and insulating fluid shall be inhibited mineral oil.

E. High and low voltage compartments shall be separated by a steel barrier.

F. Provide with drain plug and drain valve.

G. Provide with two 2-1/2% full capacity above normal and two 2-1/2% below normal taps.

H. Impedance shall be 5.75%, minimum.

I. Basic impulse level of the primary winding shall be as specified in ANSI C57.12.00 for comparable kV class.

J. Transformer shall be of a sealed-tank construction capable of withstanding a pressure of 7 psi without permanent distortion.

K. Provide transformer with lifting hooks, jacking pads and ground pad.

L. Coil windings shall be copper.

M. High voltage terminations and equipment shall be dead-front construction and conform to ANSI C57.12.26.

N. Provide three lightning arrestors in the high voltage compartment, at rated kV distribution class, for surge protection.

O. Provide transformer with dial type thermometer, liquid-level gauge, pressure vacuum gauge and pressure relief valve. All located in a lockable box on outside of transformer.

P. Oil level plug and oil level sight glass, not gauge.

2.3 Dry-Type Transformers

A. Single-ended unit substation type, self-cooled.

B. Enclosure shall be suited for indoor installation.

C. Average temperature rise of the windings, measured by the resistance method, shall be 150ºC. when the transformer is operated at rated kVA output in a 40ºC. maximum ambient.

D. Provide with two 2-1/2% full capacity above normal and two 2-1/2% below normal taps.

E. Impedance shall be 5.75%, minimum.

F. Basic impulse level of the primary winding shall be as specified in ANSI C57.12.00 for comparable kV class.

G. Coils shall be manufactured utilizing Vacuum/Pressure Impregnation (VPI) design.

H. Coil windings shall be copper.

I. Insulating materials shall be in accordance with IEEE C57.12.01 for 220ºC. UL insulation system.

J. Transformers rated over 500kVA shall have provisions for the installation of a fan cooling system in the future.

K. Provide transformer with jacking pads, ground pad, provisions for rolling and ventilation grilles.

PART 3 - Execution

3.1 Design

A. The design engineer shall indicate the transformer on one-line diagram with kVA rating, primary and secondary voltage ratings and % impedance.

B. The design engineer shall detail the the designed location of the transformer(s) on enlarger room detail floor plans drawn to scale.

3.2 Installation

A. Install transformer on a concrete, steel-reinforced, pad.

B. Install transformer in accordance with manufacturer's instructions.

3.3 Testing

A. The design engineer shall require that the following factory tests be included in the specification of each transformer:
1. Induced potential
2. Applied potential
3. Resistance measurement
4. Ratio test
5. Polarity and phase relationship test
6. No load loss at rated voltage
7. Exciting current at rated voltage
8. Impedance and load loss
9. Quality control impulse
10. Mechanical leak test (liquid-filled only)

B. Shall comply with the International Electrical Testing Association, Inc. (NETA) and the Institute of Electrical and Electronics Engineers, Inc. (IEEE) acceptance testing specifications for medium voltage transformers.

END OF SECTION 26 12 00

SECTION 26 13 00 – MEDIUM-VOLTAGE SWITCHGEAR

PART 1 - General

1.1 Reference Standards

A. ANSI/IEEE C37.20.3, C37.20.4, 24, 48, Z55.1

B. NEMA SG5

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. Square D

B. Cutler-Hammer

C. General Electric

D. Siemens

2.2 Medium Voltage Switchgear

A. Shall be metal-enclosed switchgear with load interrupter switches.

B. Suitable for indoor or outdoor installation.

C. Provide switchgear with lightning arrestors for outdoor installations.

D. Provide switchgear with mechanical interlocks to prevent the opening of a load interrupter switch while the switch is in the closed position.

E. Incoming cable terminations shall be cable lugs.

F. Provide switchgear with copper bussing.

G. Buss ampacity shall be continuous, sized and noted by the design engineer.

H. Provide each switchgear section with a viewing window to enable visible inspection of switch blades and blown fuse indicators from outside of the enclosure.

I. Basic Impulse Level (BIL) shall be 60kV (5kV Class) or 95kV (15kV Class).

J. Maximum short circuit current rating shall be as determined by the short circuit analysis.

K. Load interrupter switch shall be rated at 600A or 1200A, continuous, and fixed-mounted on a NEMA class A-20, glass-reinforced, polyester standoff insulators.

L. Load interrupter switch shall be manually operated with quick-make/quick-break design.

M. Fuses shall be direct acting, “E” rated, and UL listed.

N. Fuses sizes shall be determined by the Design Engineer.

PART 3 - Execution

1.2 Design

A. Design engineer shall provide single-line diagram showing gear with fuses.

B. Floor plans details shall be provided with electric equipment room layouts including switchgear and other substation components drawn to scale.

C. Single-line diagram shall clearly indicate dividing lines of points of acquisition and installation responsibility.

3.2 Installation

A. Install switchgear on a 4” concrete, steel-reinforced, pad.

B. Install switchgear in accordance with manufacturer’s instructions.

3.3 Testing

A. Shall comply with the International Electrical Testing Association, Inc. (NETA) and the Institute of Electrical and Electronics Engineers, Inc. (IEEE) acceptance testing specifications for medium voltage switchgear.

END OF SECTION 26 13 00

SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

PART 1 - General

1.1 Warranty

A. One year from substantial completion date.

1.2 Manufacturer

A. Square D

B. Culter-Hammer

C. General Electric

D. Siemens

1.3 Dry-Type Transformer

A. Unless otherwise indicated or scheduled, three-phase transformers shall be dry-type 480-volt delta primary and 208/120-volt wye secondary. Transformers 15 kVA and larger, provide a minimum of four (4) 2-1/2% full capacity primary taps. Exact voltages and taps to be as designated on the Drawings or the Transformer Schedule.

B. Sizing - All transformers may be sized for their allowable overload.

C. Insulation Systems:
1. 2 kVA and below: 150 degree C insulation system based upon 80 degree C maximum temperature rise above 40 degree C ambient.
2. 3 to 15kVA: 185 degree C insulation based upon 115 degree C maximum temperature rise above 40 degree C ambient.
3. 15 kVA and above: 220 degree insulation system based upon 115 degree C maximum temperature rise above 40 degree C ambient.
4. Insulation materials: flame retardant, not supporting combustion, as defined by ASTM Standard Test Method D635 and NEMA ST-20.
5. Core and Coil Assemblies:
   a. Core: Constructed of high grade, non-aging silicon steel with high magnetic permeability, low hysteresis and eddy current losses. Maximum magnetic flux densities shall be maintained substantially below the saturation point. Provide core volume sufficient to allow efficient operation a 10% above highest tap voltage. Clamp and compress core laminations together using structural steel angles.

b. Transformer Coils: Continuous wound copper conductor.
c. Units rated 15KVA and below: Encapsulate assembled core and coil in a resin and aggregate mixture, providing a moisture proof and shock resistant seal.
d. Units rated greater than 15KVA: Impregnate assembled core and coil using non-hydroscopic, thermo-setting varnish and heat cure to seal out moisture Secure the completed core and coil to the base using vibration absorbing mounts, without metal-to-metal contact between the core and coil and the enclosure.

6. Enclosures:
   a. Units rated above 15kVA: NEMA 2, ventilated and drip proof, constructed of heavy gauge, cold rolled sheet steel.
   b. Units rated 15kVA and below: NEMA 3R, totally enclosed, non-ventilated, constructed of heavy gauge, cold rolled sheet steel and suitable for wall mounting.
   c. Finish: Degreased, cleaned, phosphatized, primed, and finished with a gray, weather-resistance enamel.
7. Maximum temperature of the top of the enclosure shall not exceed 35degree C rise above a 40 degree C ambient.
8. The following information shall be indicated on Contract Document One-line and Riser Diagrams when designing systems with 480 volt delta primary and 120/208 volt wye secondary dry type transformers:
   a. Transformer KVA
   b. Transformer primary (480V, 30/) full load current (FLA).
   c. Primary overcurrent protection size (based on closest overcurrent device to 1.25 times FLA).
   d. Primary conductor to be used with the overcurrent device.
   e. Transformer secondary (120/208V, 30/) full load current.
   f. Secondary overcurrent protection size (based on closest overcurrent device to 1.25 times FLA).
   g. Secondary conductor to be used with the overcurrent device.
9. Dry type transformers 75kVA and larger must be floor mounted. Wall mounted transformers 45kVA and below are acceptable but not desirable.
10. Provide K-13480volt delta primary and 120/208 volt wye secondary rated dry type transformers to serve non-linear loads.

PART 2 - Execution

2.1 Installation

A. The design engineer shall specify that all transformers be installed Install in accordance with the recommendations of ANSI C57.12.94 and the requirements of NEC 70. Prior to energizing transformers 50kVA and above, perform insulation resistance and ratio tests as recommended by ANSI C57.12.94

B. Isolate line and load side terminations using a minimum of 24" flexible conduit.

C. Provide a 3-1/2" housekeeping pad at each transformer. Provide vibration isolation at each point of contact with building or supporting members using Korfund Corporation Type EU devices or equivalent.

END OF SECTION 26 22 00

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - General

1.1 Reference Standards

A. ANSI C57.13; NEMA AB 1, PB 2, PB 2.1, PB 2.2; UL 50, 98, 489, 891, 943.

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. Cutler-Hammer.

B. General Electric Company.

C. Siemens.

D. Square D Company.

2.2 Switchboard

A. Shall be service-entrance rated.

B. Suitable for indoor or outdoor installation.

C. Shall be deadfront, metal enclosed, self-supporting structure, independent of wall supports.

D. Bus shall be silver-plated copper and be of sufficient cross-sectional area to meet UL 891 temperature rise requirements.

E. Bussing shall travel the entire length of each vertical section.

F. Neutral bus shall be of full capacity.

G. Provide ground bus, sized per UL 891, extending the entire length of the switchboard and secured to each vertical section of the structure.

H. Horizontal busses shall be non-tapering and have provisions for future extension.

I. Main and distribution overcurrent protective devices shall be molded case circuit breakers rated at 80%.

J. Provide electronic trip accessory for overcurrent protective devices rated at 1000-amps or greater. Circuit breaker trip system shall be microprocessor-based, true RMS sensing, stored energy type circuit breakers with rating plugs. Circuit breakers shall have field-adjustable LSIG trip settings.

K. Distribution circuit breakers shall be group-mounted up to 1200A.

L. Provided switchboard with a digital power meter to indicate the following basic values: Amps, Volts, kW, kVAR, Power Factor, kWh, kVARh, kVAh.

M. Provide switchboard with a transient voltage surge suppression device unit (See section 26 43 00).

N. Provide front accessibility only.

PART 3 - Execution

3.1 Installation

A. Install switchboard on a concrete, steel-reinforced, pad.

B. Install switchboard in accordance with manufacturer's instructions.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - Products

1.1 Manufacturer

A. Cutler-Hammer.

B. General Electric Company.

C. Siemens.

D. Square D Company.

1.2 Panelboard

A. Suitable for indoor or outdoor installation.

B. Shall be flush-mounted or surface-mounted.

C. Bus shall be 98% conductivity copper, and bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67.

D. Bus shall be installed completely throughout panel to permit addition of new bolt-on breakers in available space in future without modifying bus.

E. Provide one (1) continuous bus bar per phase the entire length of the panel.

F. Bus bars shall have sequentially phased branch circuit connectors for bolt-on circuit breakers only.

G. Provide a solidly bonded copper ground bus.

H. Provide split solid neutral bus rated at full capacity.

I. Main and branch overcurrent protective devices shall be bolt-on, molded case circuit breakers.

J. All panel boards shall have door locks. The front cover shall be a door in door arrangement with the inner door hinged to allow access to breaker handles. Provide each panel with hinged trim to allow access to wiring compartments without trim removal.

K. Unless a greater fault current rating is required, integrated equipment ratings shall be not less than 10,000 amps symmetrical for 208V panels and 14,000 amps symmetrical for 480V panels.

L. Integrated equipment ratings shall not depend on series-rated circuit breakers upstream.

M. Provide all new panelboards with 20% spare capacity for future expansion.

N. Provide a minimum of two 1" empty conduits from each flush mounted panel to an accessible point above the ceiling.

O. Panelboards shall be labeled with a descriptor indicating location, reference voltage level, and primary loads served.

P. Panel schedules need room number(s) or, if not available, description of panel location.

Q. Panelboard electrical loads shall be be balanced across the buss phases.

PART 2 - Execution

2.1 Design

A. The design engineer shall not locate panel boards in hallways or other public spaces. Where an obsolete panel is being replaced in an existing public space, the new panel shall be flush mounted.

B. The design engineer shall specify that all panelboards are installed in accordance with manufacturer's instructions.

END OF SECTION 26 24 16

SECTION 26 31 00 – SOLAR PHOTOVOLTAIC (PV) COMPONENTS

PART 1 - General

1.1 References

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
1. www.dsire.org
2. http://www.gosolarcalifornia.ca.gov/equipment/
3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
   a. NFPA 1 (2015; ERTA 2015) Fire Code
   b. NFPA 70 (2017) National Electrical Code
   c. NFPA 70E (2015; ERTA 1 2015) Standard for Electrical Safety in the Workplace

1.2 Submittals

A. Submit the following in accordance with Section 01 Submittal Procedures.
1. Shop Drawings
   a. Schematic Diagrams
   b. Interconnection Diagrams
   c. Installation Drawings
2. Product Data
   a. Combiner Boxes
   b. Disconnects
   c. Ground Mounting Structure for Modules
   d. Photovoltaic Module Backsheet
   e. Photovoltaic Module Encapsulent
   f. Photovoltaic Modules
   g. Photovoltaic Wire
   h. System Monitoring

B. Design Data
   a. System Operation
   b. Calculations
   c. System Performance Calculations

C. Test Reports
   a. NABCEP Acceptance Checks and Tests
   b. NETA Acceptance Checks and Tests
2. Certificates
   a. Installer

b. Materials
c. Warranty

3. Manufacturer's Instructions
   a. Installation Instructions
4. Operation and Maintenance Data
   a. Electrical Systems
   b. Training Course

1.3 Quality Assurance

A. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

B. Installation Drawings
   1. In addition to requirements in Section Submittal Procedures, include the following:
      a. Submit drawings for government approval prior to equipment construction or integration.
      b. Submit shop drawings at a minimum of 11 by 17 inches in size.
      c. All details legible and all text no smaller than 0.1 inches in height on any drawing. As needed, provide enlargements to ensure clarity of intent.
      d. Shop drawings must include wire diagrams and installation details of photovoltaic (PV) system equipment indicating location as proposed in design drawings, layout and arrangement of PV modules, support and mounting mechanism, inverters, combiner boxes, AC and DC disconnects, equipment enclosures, conduits, monitors, meters, security systems, and all other accessories associated with the installation of the PV system. Wiring diagrams must identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each equipment item.
      e. Shop drawings may include legible copies of manufacturer's product literature, with selected items and specifications highlighted thereon.
      f. Modifications to original drawings made during installation must be immediately recorded for inclusion into the as-built drawings. When items have changed relative to the approved design, the designer must provide certification indicating that the changes will not negatively affect the system's operation or the structure supporting the system.

C. System Operation
   1. Provide a complete description of the function of each component including PV modules, DC wiring, combiner boxes, inverters, AC wiring, AC and DC disconnect switches, and monitoring system. Provide a discussion of the overall system operation.

D. Installer

1. Submit NABCEP (North American Board of Certified Energy Practitioners) PV Installation Professional certification, and a resume with references that details least four successful projects that, in aggregate, equal or exceed the size of the proposed project.

E. Materials
1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Submit proof of compliance with requirements of UL, where material or equipment is specified to comply. The label of or listing in UL Electrical Construction Directory will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing laboratory (NRTL) equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted.

F. Alternative Qualifications
1. Products having less than a 2-year field service record will be acceptable if the manufacturer has been regularly engaged in the design and production of solar photovoltaic products for a minimum of 5-years. Similar photovoltaic products must have been in satisfactory commercial or industrial use for 5-years prior to bid opening and must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 5-year period.

G. Material and Equipment Manufacturing Date
1. Products manufactured more than 1-year prior to date of delivery to site must not be used, unless specified otherwise.

H. Operation and Maintenance Data
1. Submit Solar Photovoltaic Systems data package for the following items in accordance with Operation and Maintenance Data.
   a. Troubleshooting guide.
   b. Warranty.
   c. Operation instructions.
   d. Preventive maintenance and inspection data, including a schedule for system operators.
   e. As-built plans displaying modules identified according groups or zones, coordinated with activity to organize as required.

I. Electrical Systems
1. Submit operation and maintenance data in accordance with Operation and Maintenance Data. Include the following for the actual solar photovoltaic (PV) system provided:
   a. Service and maintenance information including preventive maintenance, assembly, and disassembly procedures.
   b. Complete operation, repair, and maintenance information, detailed to the smallest replaceable unit.

c. Adjustment, trouble-shooting, configuration, tuning, and system calibration instructions.
d. Programming information for the communications and monitoring interface.
e. An instruction manual with pertinent items and information highlighted.
f. A layout drawing showing locations as well as views of equipment; front, top, and side views.
g. A one-line drawing showing all components and interfaces to the electrical system.
h. Prices for spare parts and supply list.
i. Inverter efficiency report and field acceptance test reports.
j. Actual nameplate diagram.
k. Date of purchase.

J. Training Course

1. The proposed Training Course Curriculum (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of safety and routine maintenance operations, including testing procedures included in the maintenance instructions, are to be covered. The proposed Training Course must be video-recorded and provided with any PowerPoint slides as part of the final documentation for those that cannot attend. Safety training must be extended to fire department representatives.

K. Bill of Materials

1. Submit a Bill of Materials listing each product being incorporated into the system. Bill of Materials includes a general description of the product, quantity, and exact manufacturer's model number. Where the manufacturer's model number does not fully identify the product, list options, accessories, or custom features by additional descriptions.

L. Qualified Testing Organization

1. Engage the services of a qualified testing organization, NABCEP-certified professional, or licensed electrician to provide inspection, testing, calibration, and adjustment of the solar photovoltaic electrical distribution system and equipment listed herein. Organization must be independent of the supplier, manufacturer, and installer of the equipment. The organization must be a first tier contractor.
2. Submit name and qualifications of organization. Organization must have been regularly engaged in the testing of electrical materials, devices, installations, and regularly engaged in solar PV systems for a minimum of five years.
   a. Organization calibration program requirements:
      1) Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
      2) Accuracy: Traceable to the National Institute of Standards and Technology.
      3) Instrument calibration frequency schedule: Less than or equal to 12 months for both test floor instruments and leased specialty equipment.
      4) Dated calibration tables: Visible on all test equipment.
      5) Calibrating standard: Higher accuracy than that of the instrument tested.

6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
   a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
   b) Identify the third party laboratory calibrated instrument to verify that calibrating standard is met.

M. System Performance Calculations
1. Submit system performance calculations to show that the components provided will produce the minimum required production of power in accordance with PERFORMANCE REQUIREMENTS paragraph.
   a. DELIVERY, STORAGE, AND HANDLING.
      1) Store solar PV modules in their original packaging according to the manufacturer's guidance, and do not remove from packaging until day of installation.
      2) If a solar PV module is removed from its packaging, store it according to the manufacturer's guidance.
      3) Do not store solar PV modules on-site for more than 12 months.

N. Warranty
1. Submit warranty information in accordance with PART 2 - Products.
2. The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
3. Solar Photovoltaic Modules
   a. Furnish the solar photovoltaic module manufacturer's warranty. The warranty must be a 25-year linear 80 percent (minimum) power production warranty (at the end of the 25th year after purchase an actual minimum power output of 80 percent based on the nameplate rating must be achieved) and not less than 10-years for workmanship material and manufacturing defects from the date of manufacture.
   b. The warranty must state that the malfunctioning solar photovoltaic module must be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement solar module must be identical to, or an improvement upon, the original design of the malfunctioning solar module. Provide two (2) extra spare modules in the event of necessary replacement of malfunctioning installed module

O. Health and Safety Recommendations
1. Government and Safety Requirements applies to this section with additions and modifications specified herein.

PART 2 - Products

2.1 Solar Module / Panel

A. Efficiency
1. Minimum module efficiency of 17 percent.

B. Warranties (Performance and Product)
1. Product/Materials
a. Minimum 10 year equipment warranty.
2. Performance
a. Minimum 25 year power production warranty.
b. Guaranteed minimum 80 percent power output over product life.

C. Rating
1. Minimum 250 watt nameplate (STC) power rating with power tolerance of +/- 5 percent.

D. Durability
1. Effect of the elements (temperature and wind) on panels should be minimal.
a. Wide temperature and high wind load ratings.

E. Compliance
1. ISO 9000
2. IEC 61215 Compliant

F. Manufacturer profile
1. Great financial health and insurance.

2.2 Inverter

A. Efficiency
1. Minimum efficiency of 95 percent.

B. Type
1. Preference for string inverters over central inverters.

C. Warranties (Product and Materials)
1. Minimum 10 year equipment warranty.

D. UL compliant

2.3 Battery

A. Efficiency
1. Minimum efficiency (conversion) of 80 percent.

B. Depth of Discharge (DOD)
1. Minimum 80 percent.

C. Temperature
1. Wide temperature range.
2. Ability to withstand extreme temperatures.

D. Warranties (Product and Materials)
1. Minimum 10 year equipment warranty.

2.4 Energy Meter

A. Must have a dashboard/display capability.
1. User interface free of charge.

B. Internet enabled and web interface.

C. Data Recording
1. Measure AC and DC power to nearest watt/sec: W, KW, KWH, V, PF
2. Measures up to minimum 15 circuits
3. Record historical data
   a. Up to lifetime of energy system.
   b. Consumption and production.

D. Energy efficient
1. Low power consumption.

2.5 Charge Controller

A. Must be maximum power point tracking (MPPT)

B. Efficiency
1. Minimum power conversion of 95 percent.

C. Data Recording
1. Status display and/or dashboard capability.
2. Record historical data.

D. Temperature

1. Wide temperature range.
2. Ability to withstand extreme temperatures.
3. Including battery temperature sensor.

E. Warranties (Product and Materials)
1. Minimum 5 year equipment warranty.

F. Energy efficient
1. Low power consumption.

2.6 Mounting Hardware

A. Durability
1. Effect of the elements (temperature and wind) on panels should be minimal.
   a. Wide temperature and high wind load ratings.

B. Racking should require minimal roof penetration (if applicable).

C. Compliance
1. UL
2. ANSI

D. Warranties (Product and Materials)
1. Minimum 25 year equipment warranty.

2.7 Capacity
1. As specified on a per project basis.

2.8 Voltage
1. As specified on a per project basis.
   a. Project/site/location specific.

2.9 Equipment Enclosure
1. All listed equipment (products), except the Solar Module/Panel shall be installed at a location with minimal exposure to the elements (sun, rain, snow) and properly ventilated. They may be installed in enclosed space if feasible.
   a. Additionally, see equipment specification sheet for manufacturer's recommended installation location guidelines.

2.10 Interconnection to Power Grid
1. Determined by local jurisdiction and/or utility having jurisdiction.

2. Contact local jurisdiction and/or utility for rules and requirements.

PART 3 - Execution

3.1 Installation Instruction and Installation Drawings

A. Governing Codes
1. Complete all electrical work in accordance with NFPA 70.
2. Follow all applicable building and electrical codes.
3. Follow local authority requirements and utility guidelines.

B. Location
1. Location of installation of SOLAR PHOTOVOLTAIC (PV) COMPONENTS is project specific.
   a. This may include but is not limited to the following:
      1) Roof mounted
      2) Ground mounted
      3) Solar carports/canopies
2. Batteries, controller, and inverter locations.
   a. Project specific. This may include but is not limited to the following:
      1) Cabinet mounted and located in an electrical room or closet.
         a) Installed in electrical room/closet if the room/closet is a reasonable distance from the array location.
         b) The goal is to minimize exposure to the elements and reduce cost of running conduit and wires.

C. Provide all permanent and temporary shoring, anchoring, and bracing required by the nature of this work in order to make all parts absolutely stable and rigid, even when such shoring, anchoring, and bracing are not explicitly called for.

D. Install the solar PV system in accordance with this section, installation drawings, and the printed installation instructions of the manufacturer.

E. Follow the manufacturer's installation recommendations to ensure no electricity is being fed to the grid and that all available disconnects are in the open position and fuses are not installed during wiring operations. Utilize on-site measurements in conjunction with engineering designs to accurately cut wires and layout before making permanent connections. Locate wires out of the way of windows, doors, openings, and other hazards. Ensure wires are free of snags and sharp edges that have the potential to compromise the wire insulation. If the system is roof-mounted, it must have direct current ground fault protection in accordance with NFPA 70. Ensure breakers in combiner box are in the off position (or fuses removed) during combiner box wiring.

F. Attach solar PV modules to the mounting structure according to the manufacturer's instructions and approved plans.

G. Install instrumentation according to the manufacturer's instructions, with control panels located as indicated.

H. Wiring Methods
1. Install wiring in accordance with NFPA 70.

I. Electrical Connections
1. Use twist on wire connectors listed for the environment (i.e. wet, damp, direct burial) and installed per manufacturer's instructions.
2. Use listed power distribution blocks.
3. Use terminals containing more than one conductor listed for multiple conductors.
4. Use connectors and terminals used for fine strand conductors that are listed for use with such conductors.
5. Utilize appropriate tools for connector type as recommended by the manufacturer.
6. Tighten and secure module connectors.
7. Provide corrosion protection by adding a stainless steel isolating washer between components of incompatible metals on the racking structure.

J. Disconnects
1. Install disconnects for all current carrying conductors of the PV source.
2. Install disconnects for the PV equipment. For inverters and other equipment that are energized from more than one source, group and identify the disconnecting means.
3. Install disconnects and overcurrent protection for all ungrounded conductors in ungrounded (transformerless) PV power systems.

K. Overcurrent Protection
1. Install the PV interconnect overcurrent protective device as indicated in accordance with NFPA 70.
2. Install lightning arrestor as indicated and in accordance with NFPA 780.

L. Fire Safety
1. Firestop conduit that penetrates fire-rated walls, fire-rated partitions, or fire-rated floors.

M. Groundings
1. PV System Grounding
   a. NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 10 ohms.
   b. Install grounding lugs in locations on the solar PV module as designated by the module manufacturer, using stainless steel machine screws of the thread size provided in the pre-tapped holes, along with a stainless steel star washer placed between the grounding lug and the solar module frame.
2. Grounding Electrodes

a. Provide driven stainless steel ground. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

N. Installation of Equipment and Assemblies
1. Ground Mounted Structures
a. For concrete ballast or pad, install in accordance with STRUCTURAL STEEL specifications.

O. Nameplate Mounting
a. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

P. Warning Signs Mounting
a. Display calculated maximum and minimum voltages and their respective amperages on engraved warning labels.
b. Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

Q. Cable Tag Installation
1. Install cable tags in each manhole, handhole, and vault as specified, including each splice. [Tag only new wire and cable provided and existing wire and cable which are indicated to have splices and terminations provided.] Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

R. Field Quality Control
1. Perform in accordance with Specifications.
2. Performance of NABCEP Acceptance Checks and Tests
a. Perform all inspections using a NABCEP-certified professional and in accordance with NABCEP inspection procedures, and in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests.
3. PV Modules
a. Visual and Mechanical Inspection
1) Solar PV module manufacturer, model, and number of modules must match the approved plans.
2) Solar PV modules must be in good conditions (including but not limited to no broken glass or cells, no discoloration, frames not damaged).
b. Electrical Tests
1) Verify output of PV modules according to manufacturer's recommendations and NABCEP practices.
4. Performance of NETA Acceptance Checks and Tests

a. Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

b. Grounding System
   1) Visual and Mechanical Inspection
   2) Inspect ground system for compliance with contract plans and specifications.

c. Electrical Tests
   1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod, perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
   2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

d. Functional Acceptance Tests
   1) Provide final and complete commissioning of the solar PV system in accordance with IEEE 1547.
   2) Verify that all electrical components are installed and connected according to the requirements of the PV electrical drawings, specifications, and manufacturer's written instructions.
   3) Before starting or operating the system, check continuity of all conductors and grounding conductors to verify that there are no faults and that all equipment has been properly installed according to the manufacturer's recommendations. Check factory instructions to see that installations have been made accordingly. Check equipment for any damage that may have occurred during shipment, after delivery, or during installation. Replace damaged equipment.
   4) Before starting or operating the system, obtain a final inspection approval and final inspection from the Contracting Officer. Be present on site for both of these inspections.
   5) Make final adjustments to all inverters and monitoring equipment so that they will be placed in an acceptable operating condition. Adjustable parameters must be set so that the PV system will produce the maximum possible amount of energy on an annual basis.

S. Closeout Activities

1. Demonstration

a. Upon completion of the work and at a time approved by the Contracting Officer, provide instructions by a qualified instructor to the Government personnel in the

proper adjustment, system operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Government personnel must receive training comparable to the equipment manufacturer's factory training. Instructor must provide a separate training course for the monitoring system.

b. Instructor's Qualification Resume
   1) Instructor(s) must be employee(s) of [installer] [manufacturer] [certified solar photovoltaic system training program]. Instructors must be thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work. Submit the name(s) and qualification resume(s) of instructor(s) to the Contracting Officer for approval.

c. Training Plan
   1) The training period must consist of a total of two (2) hours of normal working time and begin after the system is functionally completed but prior to final acceptance tests. Submit the training course curriculum for approval, along with the proposed training date, at least 14 days prior to the date of proposed conduction of the training course. Instruction must be [video-recorded and] given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Provide [video recording and] any PowerPoint slides as part of the final documentation for those that cannot attend. Extend safety training to fire department representatives. Coordinate with Contracting Officer for Fire Department first responder training.

END OF SECTION 26 31 00

SECTION 26 32 13 – DIESEL-ENGINE DRIVEN GENERATOR SETS

PART 1 - General

1.1 Reference

A. National Electrical Code (NEC).

B. National Electrical Manufacturers Association (NEMA).

C. National Fire Prevention Association (NFPA 90).

D. National Fire Prevention Association (NFPA 110).

E. Underwriters Laboratory (UL).

1.2 Warranty

A. One year from substantial completion.

PART 2 - Products

2.1 Manufacturers

A. Caterpillar

B. Generac

C. Cummins

D. Onan

2.2 Engine Generator

A. Engine may be Type 2 diesel for Generators for all kW sizes.

B. Diesel engine: the motor/generator unit shall be rated as a stand-by service for handling 120% of critical loads. (Critical loads being defined as lifesaving systems (fire alarm), elevators and any other loads specified on building plans). Further criteria for the system are a 0.8 power factor, three phase, 60 cycle. System shall be package equipment consisting of:

1. Engine mounted start/stop control system.
2. A remote mounted emergency push-button, of the red “mushroom” type. Provide conduit and wiring provisions for mounting of push-button up to 50’-0”.
3. Other mounted accessories as specified.

C. Provide with woodwork isochronous governor for non-linear loads.

D. Engine shall be diesel fueled four cycle, water-cooled, with mounted radiator, fan and water pump. A rating of continuous horsepower at the operating speed of no more than 1800 RPM shall be developed to drive the generator continuously without overload. Full pressure lubrication shall be supplied by gear oil pump. Engine shall have an oil filter with replaceable element; oil cooler and fuel pump. Engine speed shall be governed by a hydraulic governor to maintain alternator output. Engine shall have a 24-volt, DC, battery charging alternator with transistorized voltage regulator. Starting shall be by volt, solenoid shift start.

E. Cooling system shall consist of a water-cooled radiator, blower type fan, temperature control valve, engine water inlet and outlet connected to the radiator and an engine driven jacket circulating pump. Provide combination of water and ethylene glycol anti-freeze solution to protect the radiator to 0 degrees.

F. Accessories needed for proper operation of the plant shall be furnished. These shall include critical muffler with side inlets complete with flexible connections to engine and condensate traps in riser and gravity type flapper exhaust caps, 24 volt starting circuits, battery cables, battery rack, and all interconnecting piping between day tank and engine.

G. Provide with an SCR voltage regulated battery charger with float, taper, and equalize charge settings.

H. Provide with remote annunciator panel.

I. Provide with heavy-gauge, reinforced sheet steel housing with ample air flow.

J. Provide with water jacket heater.

K. Provide with humidity control space heater.

L. Provide lead/acid storage batteries; heavy-duty, diesel starting type. Battery voltage shall be compatible with starting system. Battery set shall be of sufficient capacity to provide for 1-1/2 minutes total cranking time without recharging. Battery rack and necessary cables and clamps shall be provided. Batteries shall be isolated to prevent continuous discharge and reduce possibility of batteries discharging to point of battery cell destruction.

M. Provide current limiting battery charger to automatically recharge batteries. It shall include overload protection, silicone diode full wave rectifier, voltage surge suppressor, D.C. ammeter and

fused A.C. input. A.C. input voltages shall be same as generator output voltage. Amperage output shall be not less than 5 amperes.

2.3 Fuel Tank

A. Provide a double-walled sub-base fuel storage tank, sized by design engineer. Provide a minimal emergency runtime of 24 hours at 75% loading. Provide with vibration isolators.

2.4 Alternator

A. System shall be built, tested and shipped by manufacturer of alternator so there is one source of supply and responsibility. Performance of electrical plant series shall be certified by Independent Testing Laboratory as to plants full power rating, stability and voltage and frequency response.

B. Alternator shall be selected based on the maximum starting kVA (skVA) calculated.

C. Alternator shall be brushless, 4 pole revolving field type with rotating rectifier exciter and solid- state voltage regulator. Stator shall be directly connected to the engine flywheel housing, and rotor shall be driven through a semi-flexible driving flange to insure permanent alignment. Voltage regulation shall be within plus or minus 2% of rated voltage from no load to full load. Instantaneous voltage dip shall be less than 20% of rated when full loaded and rated power factor is applied to alternator. Recovery to stable operation is defined as operation with terminal voltage remaining constant, within plus or minus 1% of rated voltage. A rheostat shall provide minimum of plus or minus 5% of voltage adjustment from rated value. Temperature rise shall be within rating as defined by NEMA MG1-22.40.

D. The AC alternator shall be a synchronous generator, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with a flexible disc.

E. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch winding. The rotor shall have an amortisseur (damper) winding, with layer wound mechanically wedged construction. The rotor shall be dynamically balanced. Surge suppressers shall be connected in parallel with the field winding. Use of field discharge resistance shall not be acceptable. Systems using three-wire solid-state devices shall mount the unit in a stationary location.

F. The insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation. Actual temperature rise measured by the resistance method at full load of KW/KVA shall not exceed 80° C with a 40° C ambient.

G. The alternator characteristic shall be matched to the torque characteristics of the engine in such a manner that with full load connected to the generator terminals, the generator can utilize all the available engine power without exceeding it at all speeds up to and through synchronous speed.

H. The alternator bearing shall be electrically insulated from the generator end bell to block potentially damaging shaft currents caused by imprecise manufacturing tolerances or variations in electrical steel.

I. The alternator shall be equipped with heaters operating on 120 or 208 VAC to control moisture condensation. Power for heaters shall be automatically turned off when unit is running.

J. The AC output leads of the alternator shall be brought out to a main molded case thermal- magnetic circuit breaker of suitable voltage and continuous and interrupting current rating. The circuit breaker shall be UL listed and accessible through removable plates on either side of a sheet metal output box DD. A control unit shall be installed and shall include an alternator field excitation circuit breaker of suitable continuous duty and interrupting ratings; AC ammeter and 3 phase selector switch; AC voltmeter and selector switch for all phase-to-phase and phase-to- neutral voltages; frequency meter; voltage adjust rheostat with +/- 5% adjustment; automatic voltage regulator; and necessary wiring and interconnections in accordance with the wiring methods set forth elsewhere in these Specification.

2.5 Instrumentation and Controls

A. Engine instrument panel shall contain an oil pressure gauge, water temperature gauge, battery charge rate ammeter, manual starting pushbutton and speed control. Alternator instrument panel shall be wired, tested and shock mounted on the electric emergency/standby electric plant by the manufacturer of the alternator. It shall contain running time meter, AC volt meter, voltage adjusting rheostat, AC ammeter with phase selector switch, dry contacts, and remote alarms wired to terminal strips and panel lights.

B. Provide two remote alarm annunciators designed for either surface or flush mounting indicating alarm functions described in next item. Annunciator shall be sheet metal steel enclosures with removable front panels. Face of front panel shall have visual signals, audible alarms, toggle switch marked normal and off, and lamp test push button. Annunciator shall be factory wired to a terminal block and have terminals labeled.

C. Set shall be provided with necessary external contacts and factory wiring to a labeled terminal block so that following items can be connected to central alarm stations.
   1. Electric plant operating (Generating)
   2. Electric plant failed to start (over crank)
   3. Low lube oil pressure (low oil pressure)
   4. Excessive water temperature (Hi engine temperature)
   5. Low water jacket temperature (low engine temperature)
   6. Engine overspeed

7. Low fuel supply (low fuel)
8. Low battery voltage (low battery volt)

D. Complete engine start control switch operates on closing contact and stop control operates on opening contacts. Cranking limiter shall be provided to open starting circuit in approximately 45 seconds if plant is not started within that time. Electric plant controls shall also include a three-position selector switch with the following positions: RUN-STOP-REMOTE. High water temperature, low oil pressure, and over speed trips shall be provided. Signal lights and alarm terminals shall indicate when safety device has operated.

E. Central alarm station annunciator shall be equipped with dry contact output and wired to subject building energy management system.

2.6 Operating Sequence and Instructions

A. Sequence of operation shall begin upon failure of normal source of power; engine shall be automatically cranked and brought up to full operating speed required by the generator. Cranking motor circuit shall be instantly broken when the engine starts. Within 10 seconds generator shall be brought up to operating speed, generator voltage shall operate an automatic line transfer switch, transferring load from the normal source of supply and connecting emergency load. Upon restoration of normal source of supply, sequence of operation shall be reversed, stopping the engine and restoring the line transfer switch to normal operating position, disconnecting load from the emergency generator, set will continue to operate for a cool down period of 20 minutes after restoration of normal source of supply. Should engine fail to start at once, cranking cycle shall cease and 12-volt bell alarm shall be energized to indicate malfunctioning of system. Control set shall automatically stop engine in event cooling water temperature becomes too high, if oil pressure drops below a predetermined pressure, or if engine over speeds. Upon failure of engine for any reason, an indicating lamp will operate, indicating condition under which engine was shut down. Also, alarm bell signal shall be energized. Automatic line transfer switches and emergency change over mechanism, which is to be installed is not part of the engine generator set, will be described elsewhere in these specifications.

B. Operating instructions: shall be provided and installed in a suitable metal frame with cover glass making the display weather proof. Operating instructions for the emergency/standby generator shall be complete.

C. After completing of system installation, manufacturer's representative shall demonstrate to the owner or owner's representative, operation of the system. Manufacturer's representative shall certify in WRITING, to the Owner, that work was supervised, approved, and in accordance with these specifications.

2.7 Circuit Protection

A. Provide main line molded case circuit breaker of rated amperes and install as load circuit interrupting and protective device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions. Trip for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short-circuit protection. Circuit breaker shall meet standard established by NEMA, NECA, and UL codes. Generator/exciter field circuit breakers do not meet above electrical standards and are unacceptable for line protection.

PART 3 - Execution

3.1 Testing

A. Factory Prototype Model Tests: The power system consisting of prime mover, generator, transfer switches, and all necessary controls must be tested as complete systems on representative engineering prototype models. The tests, being potentially damaging to the equipment tested, must not be performed on equipment sold, but on separate prototype models. A certificate certifying that this prototype testing has been accomplished shall be submitted along with submittal data for approval. These tests shall have included:

1. Maximum power level (maximum KW).
2. Maximum motor starting capacity (maximum KVA). Measurement to be by light beam oscillograph coupled to prime mover in prototype test. Synchronous motor drive ratings will not be acceptable.
3. Structural soundness as per MGI-22.41.
4. Torsional graph analysis per MIL-STD 705B, Method 504.2. A torsional analysis shall be calculated using data from actual tests by the generator set manufacturer to verify freedom from torsional stresses within 10% of rated speed. Results shall be made available to Engineer for inspection upon request. Actual torsional fatigue test must be performed on the complete prototype generator set. Calculations based on engine and generator data separately are not acceptable.
5. Engine-alternator cooling air flow.
6. Transient response and steady-state governing.
7. Alternator temperature rise by imbedded thermocouples and by resistance method per NEMA MGI-22.40.
8. Harmonic analysis and voltage wave form deviation per MIL-STD-705B, Method 601.4 with maximum TIF Factor as per MGI-22.43.
9. Three-phase short-circuit test per MGI-22.45.
10. Overspeed capability as per MGI-22.46.
11. Endurance testing at rated load and speed is required without significant damage or failures of electrical or mechanical components occurring.

B. Factory Production Model Test: Before shipment of the equipment, the generator sets, transfer switches, and system components shall be tested as per MGI-22.40. The Engineer shall be notified in advance of these tests, and shall have the option of witnessing these tests. Certified copies of test results shall be forwarded to the Engineer for review, when requested.
   1. Single step load pickup per NFPA 99.
   2. Transient response and steady state governing.
   3. Alternator temperature rise by resistance method.
   4. Fuel consumption. (No load, 1/4, 1/2, 3/4 and full load).

C. Field Tests After Installation:
   1. The complete installation shall be initially started and checked out for operational compliance by factory trained representative of the manufacturer of the generator set and the automatic transfer switch. The engine lubrication oil and antifreeze, as recommended by the manufacturer for operation under environmental conditions specified, shall be provided by the supplier of the generator set. If transfer switches and generator sets are furnished by different manufacturers, technical representatives of both transfer switch and generator set manufacturers shall be present during the field tests to verify operational compliance.
   2. Upon completion of initial start-up and system checkout, the supplier of the generator set shall perform a field test, with the Engineer notified in advance and having the option of witnessing these tests, to demonstrate load carrying capability, stability, voltage, and frequency. The Contractor shall submit a copy of the test procedures and systems checkout lists for review prior to commencing tests.
   3. The generator set shall be run for 2 hours continuously with all available building emergency load connected to its output. Records shall be maintained throughout this period to record water temperature, oil pressure, ambient air temperature, voltage, current, frequency, kilowatts, and power factor. The above data shall be recorded at 15 minute intervals throughout the test. There shall be a 10 minute unloaded run at the conclusion of the test to allow engine to cool before shutdown. Three copies of the field test data shall be furnished to the Engineer. The Contractor shall make all necessary hook-ups to accomplish field tests and shall furnish all fuel necessary for field tests and startup.
   4. Simulated Power Failure Test: Generator set shall be made ready for automatic operation and started by means of the test transfer switch on the automatic transfer switch. Unit shall run for the duration of all time delays and then automatically shut down.

END OF SECTION 26 32 13

SECTION 26 33 53 – STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - General

1.1 Reference Standards

A. ANSI/NEMA 241, 250

B. IEEE 587, 944

C. NEMA PB2, PE1

D. UL 1012, 1778

1.2 Warranty

A. One year from substantial completion date.

PART 2 - Products

2.1 Manufacturer

A. Powerware - Eaton

B. Liebert

2.2 UPS

A. The UPS shall consist of the following major components:
   1. Power Processors including Rectifier/Charger and Inverter
   2. UPS Battery Bank, including racks. Batteries shall be sealed, maintenance free, and lead acid.
   3. Static Transfer Switch.
   4. System Metering
   5. Remote Monitor Panel
   6. Battery Disconnect Switch.
   7. Emergency power-off switch

B. Provide an external bypass with provisions to isolate and remove the whole UPS System.

C. UPS shall be designed to operate as an on-line reverse transfer system in the following modes:
   1. Normal
   2. Emergency
   3. Recharge
   4. Bypass Mode
   5. Maintenance Mode

PART 3 - Execution

1.1 Installation

A. The UPS shall operate in conjunction with the power distribution system to provide on uninterrupted source of quality power for critical electronic equipment loads.

B. The UPS when specified as a three-phase unit, shall be a three phase system in one unit. Use of three single-phase units to comprise a three phase system is not acceptable.

C. Operation of the UPS shall be demonstrated to the Engineer to prove that under emergency conditions UPS will provide power to the designated load without interruptions of functions and loss of stored information.

D. Install UPS per manufacturer's recommendations.

END OF SECTION 26 33 53

SECTION 26 43 00 – TRANSIENT VOLTAGE SUPPRESSION

PART 1 - General

1.1 Reference Standards

A. ANSI/IEEE C62.41, C62.45, C62.11 and C62.33.

B. Federal Information Processing Standards Publication 94 (FIPS PUB 94).

C. Federal Specification (W-P-115b and W-C-375a, b).

D. NEMA AB-1, PB-1, PB-1.1 and PB-1.2.

E. NFPA 70 [NEC], (75 and 780).

F. UL 50, 67, 489, 943, 1283 and 1449.

G. NEMA-LS1

1.2 Warranty

A. Provide a no less than ten (10) year warranty from date of shipment.

PART 2 - Products

2.1 Manufacturer

A. Current Technology

B. Thor Systems

C. Vertiv

2.2 Electrical Requirements

A. Unit Operating Voltage: The nominal unit operating voltage and configuration shall be as indicated on the drawings.

B. Maximum Continuous Operating Voltage (MCOV): The maximum continuous operating voltage (MCOV) of all suppression components utilized in the unit shall not be less than 125% of the

facility's nominal operating voltage for 120 volt nominal systems and not less than 115% of the facility's nominal operating voltage for 220, 240, 277, 347, 480, 575 and 600 volt nominal systems.

C. Operating Frequency: The operating frequency range of the unit shall be 50 to 400 Hertz.

D. Overcurrent Protection: The unit shall be equipped with series overcurrent protection that carries a UL 489 listing as an overcurrent device. Suppression filter system overcurrent protection shall have the same KAIC rating as the entire panel.

E. Protection Modes: The unit's primary mode of protection shall be line-to-line (delta-configured systems) or line-to-neutral (wye-configured systems). The secondary modes of protection shall be line-to-ground and neutral-to-ground (wye-configured systems) or line-to-ground (delta- configured systems).

Electrical System Ampacity at SPD Install Point	Surge Protection (kA)	
	Per Mode	Per Phase
2500 – 6000A	300	600
1200 – 2000A	250	500
600 – 1000A	200	400
225 – 400A	150	300
125 – 225A	100	200
15 – 100A	50	100

F. Maximum Impulse Surge Capacity: Based on 1991's ANSI/IEEE C62.41-standard 8 x 20 microsecond current waveform, the maximum single impulse surge current capacity, in amps, of the unit shall be no less than as follows:

G. Performance Ratings: The unit's published performance ratings shall be the UL 1449 Listed suppression ratings. The UL 1449 suppression rating shall be, for each mode of protection, not less than as follows:

	UL 1449 SUPPRESSION RATING				
VOLTAGE	**CONFIGURATION**	**L-N**	**L-G**	**N-G**	**L-L**
277/480	Grounded Wye	1200	1200	1200	2000
120/208	Grounded Wye	900	900	900	1200

H. High Frequency Extended Range Tracking Power Filter: The unit shall include a UL 1283 high-frequency extended range power filter. The unit shall reduce fast rise-time, high frequency, error producing transients and electrical line noise to harmless levels thus eliminating disturbances which may lead to system upset. The filter shall provide minimum insertion loss as follows:

Attenuation Frequency	100KHz	1MHz	10MHz	100MHz
Insert Loss (dB)	30	30	30	30

I. Surge Protection Device (SPD) Integral Monitoring: The unit shall be provided with LED Status indicators, and dry contacts. The service entrance SPD(s) shall have LED Status indicators, dry contacts, a surge event counter with re-set, and audible alarm with silence switch

J. Enclosure: The SPD shall have a NEMA 4 rating equal or greater than the connected switchboard or panel that is being protected. Weight of standard surface-mounted units shall not exceed 100 lbs. (max).

K. SCCR or AIC: The SPD shall have a minimum SCCR rating of 100k AIC or greater than that of the connected switchboard or panel that is being protected.

L. Service Entrance SPD's shall have a nominal discharge rating (In) of 20kA per UL96a 12th Edition.

PART 3 - Execution

3.1 Installation

A. The SPD shall be mounted external the switchboard(s), distribution panel(s), branch panel(s) and/or load center(s), per manufacturers installation instructions, local codes, NEC Art.110.3B and Art.285, and IEEE 1100-2005 section 8.4.2.5.
   1. The SPD connectivity shall be Type 2 per NEC2008 Art.285.24 via a dedicated 3-pole breaker, sized per the SPD manufacturers' installation instructions.
      a. If there is no available multi-pole breaker, the SPD shall have an integral to the SPD fused disconnect and the bus shall be tapped.
      b. Connection shall be via low impedance wire supplied by the SPD manufacturer.
   2. Connecting SPD conduits shall have fire stopping caulk.
   3. Contractor may reasonably rearrange breaker locations to ensure short and straight leads to SPD(s) per NEC Art.285.12.
   4. Confirm and report to the engineer the ground resistance reading of each SPD at the service entrance and SPD protected panels with separately derived grounds.
   5. SPD's with test ports shall be delivered with full featured testing equipment and test training shall be provided to the project owners, both at no additional charge, after final acceptance of project.

3.2 Testing

A. Equipment manual: The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the specified unit.

B. UL 1449 suppression ratings: Documentation of unit's UL 1449 suppression rating shall be included as required product data submittal information. Manufacturer shall make available upon request certified documentation of applicable location category testing in full compliance with ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1987 Guidelines.

C. Spare parts: A list of customer-replaceable spare parts shall be included in the unit's installation, operation and maintenance instructions. All spare parts shall be quickly and easily field- replaceable.

END OF SECTION 26 43 00

Division 27 – Communications

27	00	00	Telecommunications Infrastructure Standards
27	05	00	Common Work Results for Communications
27	10	00	Communications Cabling General Requirements
27	10	05	Grounding and Bonding For Technology Systems
27	11	00	Communications Equipment Rooms
27	13	00	Communications Backbone Cabling
27	15	00	Communications Horizontal Cabling
27	16	00	Communications Connecting Cords
27	18	00	Communications Labeling and Identification

Division 27 – Communications

SECTION 27 00 00 – TELECOMMUNICATIONS INFRASTRUCTURE STANDARDS

PART 1 - Document Purpose

1.1 The Alamo Colleges Telecommunications Infrastructure Standard is a guideline for structured cabling infrastructure systems and spaces to be applied by the design team for new or renovated facilities. Information herein is applicable to the technical designer, Architect, MEP, and contractors, and shall be taken into account for each project by all team members.

A. The standard sets forth parameters for the technical system, in addition to the site and building requirements, to facilitate a properly-installed standards-compliant cabling plant, organized as follows:

1. Telecommunications Spaces; Architectural, HVAC, Power, Entrance Pathways and Conduits
2. Pathways; Cable Management in Telecommunications Spaces, Cable Support in Pathways
3. System Requirements; Backbone Cabling, Horizontal Cabling, Grounding, Labeling, Testing, and As-Built Documentation.
4. Telecommunications Diagrams; Backbone, Building MDF/IDF configuration, MFD/IDF layouts & Rack elevations

1.2 The standard addresses infrastructure for non-specialty campus buildings and is not intended for the design of data centers or specialty facilities, of which should be considered on a case-by-case basis.

1.3 Designers shall not deviate from this standard without explicit written approval from the owner.

1.4 Design team shall coordinate and schedule meeting with Alamo College's Technology Department to review the following:

A. Overall standards document.

B. Technology specifications document.

C. MDF/IDF layout.

D. Horizontal cabling design.

E. Backbone and Uplink cabling design.

F. Electrical power needs within MDF/IDF spaces.

G. HVAC design within MDF/IDF spaces.

H. Telecom grounding system design

1.5 Any deviations shall immediately be brought to the attention of the owner's representative in writing for resolution.

1.6 Where specific product brands are mentioned, an equal equivalent will be considered following an official submission of product literature and acceptance by the Alamo Colleges Information Technology Services (ITS) Department.

1.7 Where means, methods, and best practices are mentioned, contractor shall follow the manufacturers' and owner's requirements, industry standards, or code, whichever is most stringent.

1.8 Basic contractor qualifications are set forth, but may be made more stringent as applicable to each project based upon size and scope.

PART 2 - Document History

2.1 This document supersedes all previous standards which have been fully reevaluated and described herein by the Alamo Colleges Information Technology Services Department, and Facilities Operations and Construction Management Department.

2.2 The contents of the standard were derived by the assembly and input from ITS and Facilities Operations and Construction Management members.

PART 3 - Industry Standards

3.1 The following industry standards shall be adhered to, unless specifically directed otherwise, by Alamo Colleges. The list is not all-inclusive and does not alleviate compliance with applicable standards, codes, and best practices:

A. TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises

B. TIA-568-C.1 Commercial Building Telecommunication Cabling Standards – Part 1 General Requirements (2008)

C. TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard (2009)

D. TIA-568-C.3 Optical Fiber Cabling Components Standard (2009)

E. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces - (October 2004)

F. TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

G. TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure - (May 2002)

H. ANSI J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications - (October 2002)

I. TIA-758-A Customer-owned Outside Plant Telecommunications Infrastructure Standard - (August 2004)

J. TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

K. TIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 - (February 2002)

L. TIA-526-14-A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – OFSTP-14 - (August 1998)

M. ADA – Americans with Disabilities Act of 2010 www.ada.gov/2010ADAstandards_index.htm

N. AIA – American Institute of Architects www.aia.org

O. ANSI – American National Standards Institute www.ansi.org

P. ASHE – American Society of Healthcare Engineering (delete if not healthcare) www.ashe.org

Q. ASTM – American Society of Testing and Materials www.astm.org

R. BICSI – Building Industry Consulting Service International, Inc. (RCDD Standards)

S. www.bicsi.org

T. CFR – Code of Federal Regulations www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR (Available from the Government Printing Office)

U. (Material is usually first published in the Federal Register)

V. U.S. Copyright Law, December 2011 www.copyright.gov/title17

W. ECIA – Electronic Components Industry Association ESC – EIA Standards Council

X. www.eciaonline.org

Y. IACS – International Annealed Copper Standard www.ndt-ed.org/GeneralResources/IACS/IACS.htm

Z. IEC – International Electrotechnical Commission www.iec.ch

AA. IEEE – Institute of Electrical and Electronics Engineers standards.ieee.org

BB. ISO – International Organization for Standardization www.iso.org

CC. ITU-T – International Telecommunication Union – Telecommunication www.itu.int

DD. NEC – National Electrical Code (NFPA 70)

EE. maintained by NFPA – National Fire Protection Association www.nfpa.org

FF. NECA – National Electrical Contractors Association www.necanet.org

GG. NEMA – National Electrical Manufacturers' Association www.nema.org

HH. OSHA – Occupational Safety and Health Administration (U.S. Department of Labor, OSHA)

II. www.osha.gov

JJ. TIA – Telecommunications Industry Association www.tiaonline.org/standards

KK. UL – Underwriters' Laboratories www.ul.com

LL. Applicable Flame Test: UL 910 (NFPA 262 1990).

PART 4 - Contractor Qualifications

4.1 The designer shall include the following Contractor Minimum Qualifications with each project specification:

A. Contractor shall be certified by the manufacturer of all products to furnish a 15-year performance certification for cabling and connectivity, and applicable manufacturer warranties for the remaining products.

4.2 Specific project contractual documents and or requirements developed by the A/E design team for construction shall supersede this standards document.

4.3 Company has the required Prior Project Experience: At least 5 years of installation of structured cabling systems. My company can provide a minimum of three (3) project references that have/had a similar scope and each project equal at least 80% of the base bid price for this project.

4.4 References must include contact name, phone number, email address, brief description of project, date of completion, and contract amount.

4.5 Company meets all of the following minimum qualifications in order to be considered qualified to perform this contract. My company certifies that it:

4.6 Maintain installers/technicians, certified in the solution being proposed herein.

4.7 Can respond on-site to standard service calls within 8 hours (business hours) time. Can respond on-site to emergency service calls within 4 hours (business hours) time.

PART 5 - Nomenclature

5.1 In many cases, industry nomenclature is used, but is blended with district-specific terms to best suit the College's needs.

A. Industry Specific
1. MDF – Main Distribution Frame, the main point of connection for service providers, houses the backbone terminations and telecommunications equipment for cross-connection and distribution to Intermediate Distribution Frames, and cross-connection to user workstations.
2. IDF – Intermediate Distribution Frame, houses the backbone terminations and telecommunications equipment for cross-connection and distribution to user workstations.

B. Alamo Colleges Specific
1. Campus MDF – MDF that serves the entire campus by distributing backbone connections to the first IDF in each other building on campus and to the IDF-2s of the building in which it resides, and cross-connection to user workstations.
2. Building MDF – MDF that that distributes backbone cables to the IDF-2s in the building in which it resides, and cross-connection to user workstations. Applies to stand alone single-buildings.
3. IDF-1 – the first IDF in every other campus building that distributes backbone cabling to the IDF-2s of the building in which it resides, and cross connects to user workstations. Does not

apply to the building with the Campus MDF or stand- alone single buildings with a Building MDF.

4. IDF-2 – IDFs that are not serving as an IDF-1, receive backbone cabling from the Campus MDF, Building MDF, or IDF-1, and cross connects to user workstations.

PART 6 - District Infrastructure Standards

6.1 Telecommunications Spaces

A. Campus MDF (does not apply to a stand-alone single-building facility)

1. Description
   a. The Campus MDF is a Telecommunications space that serves a multi- building facility or campus. There is only (1) on each campus.
   b. The Campus MDF houses the entrance conduits, terminations, and cross connections for all incoming inter-building backbone cabling from the IDF-1s in other buildings on the campus and the intra-building backbone cabling from the IDF-2s of the building in which it resides, and cross connects to user workstations.
   c. Wall and floor space shall be reserved for service provider demarcation equipment and incoming infrastructure terminations.
   d. Campus distribution network equipment, servers, and other centralized telecommunications related equipment will reside in the Campus MDF; the Campus MDF is not intended to support academic or district servers, which will reside in separate space.
   e. The Campus MDF may share space with other systems such as security panels, fire alarm panels, paging systems, CATV, and building control panels.
   f. The Campus MDF shall not be used for storage, serve as a mechanical or electrical distribution space, nor shall it have, within its space, main electrical feeds, water or sprinkler main lines.
   g. The layout of racks, cabinets, wall fields, and cable management shall be as indicated on the attached diagrams.
2. Architectural (Campus MDF)
   a. The Campus MDF shall me a minimum of 600 square feet with a minimum clear lineal wall length of at least 30 feet; all walls shall go to deck. Refer to MDF diagram for dimensions as minimum depth and wide are critical to proper front/rear rack clearances.
   b. The floor is not required to be raised; floor finish shall be sealed bare concrete.
   c. The Campus MDF shall not contain windows.
   d. Campus MDF shall have an exterior wall that is within 50 feet of the building exterior, and not be located adjacent to or below restrooms or other water- based facilities, or sources of EMI and mechanical vibration.
   e. All walls of the Campus MDF shall be covered with AC Grade ¾" Fire Retardant Plywood, aligned vertically starting at 18 inches above finished floor extending to

114" above finished floor. The plywood shall be painted, but contractor shall take care to cover fire rating stamps on each piece of plywood. Contractor shall ensure fire-rated stamp is not painted or covered.

f. The room shall be without a ceiling, if possible, or a lift-out tile ceiling, when required. Cables or devices penetrating the ceiling tiles shall not pass through a bare ceiling tile but shall be routed through adequately sized bushings. The ceiling shall be a minimum of 24 inches above the highest rack or cable runway; 36 inches is recommended.

g. Entry to the space shall be through a minimum 42-inch by 80-inch clear door opening that swings outward. Door shall be solid core or steel with no window. The door shall securely lock and access shall only be by Alamo Colleges - approved personnel. The door shall open to an interior hallway or space; it is not recommended that the door open to the exterior of the building.

h. When an access control security system is available, the entrance to the Campus MDF shall be equipped with a proximity card reader and electrified door hardware. When a surveillance system is available, the Campus MDF shall be equipped with at least (1) camera.

i. Fire suppression for the Campus MDF shall be sprinklers in the MDF when the remainder of the building is equipped with a sprinkler system.

1) A pre-action fire suppression system shall be considered by the design team on a case-by-case basis. For each project, the design team (architect, MEP and technology consultant) shall coordinate meeting with the Owner to discuss full MEP design including pre-action fire suppression system needs.

3. HVAC (Campus MDF)

a. The Campus MDF shall be serviced by a dedicated air conditioning unit that is part of the building's main system and managed and monitored by the building management system. The unit shall maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, or the current ASHRAE recommendations at the time of construction.

b. Typically, the minimum HVAC load shall be designed to displace 20KW of power, or 6 Tons, and shall be designed to load, if the known load is greater at the time of design. For each project, the design team (architect, MEP and technology consultant) shall coordinate a meeting with the Owner to discuss full MEP design including HVAC system needs.

c. It is recommended that the Campus MDF maintain the stated temperature and humidity in the event of building power outages or primary HVAC system failure.

d. Air delivery shall be aligned in the front of the equipment rows and returns at the rear of the equipment rows.

4. Lighting (Campus MDF)

a. Fluorescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended. Lighting shall be a minimum of 50-foot candles measured at 3 feet above the floor in the entire space.

b. The Campus MDF shall be equipped with emergency lighting to keep the space lit during power outages.

5. Power (Campus MDF)
   a. Power for the Campus MDF shall be in two categories: dedicated and convenience.
   b. Dedicated
      1) The Campus MDF shall be equipped with (2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s). The originating electrical panel will be equipped with (2) 150 AMP breakers. Conductors shall be routed from the panel in conduit to the UPS wiring terminals. Each outlet shall be labeled with circuit and panel.
      2) The Campus MDF shall be equipped with a minimum of (1) APC Symmetra LX 16kVA, Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load. An additional circuit and space shall be allocated should the load exceed 16kVA and a second UPS be required.
      3) Additional power circuits to be allocated to security, fire alarm, CATV, building controls, and service provider equipment shall be considered and coordinated at the time of building design.
      4) Power distribution to the racks and cabinets shall be achieved by installing PDUs which are not within the scope of this document and are to be provided by the Alamo Colleges network department.
      5) For each project, the design team (architect, MEP, and technology consultant) shall coordinate a meeting with the Owner to discuss full MEP design including HVAC system needs.
   c. Convenience
      1) The Campus MDF shall be equipped with 20 Amp Duplex NEMA 5-20R receptacles, with maximum (6) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.
      2) A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) Duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.
      3) Refer to MDF layout diagrams for outlet locations.
6. Racks and Cable Management (Campus MDF)
   a. The Campus MDF shall be equipped with four (4) Standard 2-post Equipment Racks.
      1) Each rack shall be equipped with a vertical cable manager on both sides of the rack. Adjacent racks may share a vertical wire manager between them.
      2) Each rack shall be equipped with a horizontal wire manager above and below each horizontal patch panel.
   b. The Campus MDF shall be equipped with (2) Server Cabinets. Cabinets shall be bayed together with removable side panels when mounted adjacently. The fronts of the cabinets shall face the front of the future cabinet row to allow for a hot row cold row configuration.
      1) Space shall be allocated for an additional (7) future Server Cabinets.
      2) Space equivalent to (2) Server Cabinets shall be allocated for service provider equipment.

c. The Campus MDF shall be equipped with cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (3) times.
   1) Cable runway shall attach to the tops of Standard Equipment Racks utilizing rack-to-runway hardware kits.
   2) Cable runway shall suspend above Server Cabinets and be supported overhead by all thread to the building structure utilizing manufacturer- approved hardware and methods.
   3) A vertical section of cable runway shall be attached to the wall board to manage backbone and service provider cables as they transition from the entrance conduits to the overhead cable runway.

7. Fiber Routing System
   a. In each MDF, Design shall include a Fiber Routing System horizontally adjacent to above rack tray system. All fiber cables shall be placed in Fiber Routing System.
   b. Duct shall be made of 6”x4” yellow PVC material. All straight sections, corners and drop out shall be part of a complete manufactured system.

B. Building MDF (does not apply to a multi-building campus facility)
1. Description
   a. The Building MDF is a Telecommunications space that serves a single stand- alone building that is not part of a multi-building campus. There is only (1) in each stand-alone building.
   b. The Building MDF houses the entrance conduits, terminations, and cross connections for all incoming intra-building backbone cabling from the IDF-2s of the building in which it resides, and cross connects to user workstations.
   c. Wall and floor space shall be reserved for service provider demarcation equipment and incoming infrastructure terminations.
   d. Building distribution network equipment, servers, and other telecommunications related equipment will reside in the Building MDF.
   e. The Building MDF may share space with other systems such as security panels, fire alarm panels, paging systems, CATV, and building control panels.
   f. The Building MDF shall not be used for storage, serve as a mechanical or electrical distribution space, nor shall it have within its space main electrical feeds, water or sprinkler main lines.
   g. The layout of racks, cabinets, wall fields and cable management shall be as indicated on the attached diagram.
2. Architectural (Building MDF)
   a. The Building MDF shall me a minimum of 400 square feet with a minimum clear linear wall length of at least 25 feet; all walls shall go to deck.
   b. The floor is not required to be raised; floor finish shall be sealed bare concrete.
   c. The Building MDF shall not contain windows.
   d. Building MDF shall have an exterior wall that is within 50 feet of the building exterior, and not be located adjacent to or below restrooms or other water- based facilities, or sources of EMI and mechanical vibration.

e. Fluorescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended. Lighting shall be a minimum of 50-foot candles measured at 3 feet above the floor in the entire space.
f. The room shall be without a ceiling if possible or a lift-out tile ceiling when required. Cables or devices penetrating the ceiling tiles shall not pass through a bare ceiling tile but shall be routed through adequately sized bushings. The ceiling shall be a minimum of 24 inches above the highest rack or cable runway, 36 inches is recommended.
g. Entry to the space shall be through a minimum 42-inch by 80-inch clear door opening that swings outward. Door shall be solid core or steel with no window. The door shall securely lock, and access shall only be by Alamo Colleges approved personnel. The door shall open to an interior hallway or space; it is not recommended that the door open to the exterior of the building.
h. When an access control security system is available, the entrance to the Campus MDF shall be equipped with a proximity card reader and electrified door hardware. When a surveillance system is available, the Building MDF shall be equipped with at least (1) camera.
i. Fire suppression for the Building MDF shall be sprinklers in the MDF when the remainder of the building is equipped with a sprinkler system.
    1) A pre-action fire suppression system shall be considered by the design team on a case-by-case basis.

3. HVAC (Building MDF)
    a. The Building MDF shall be serviced by a dedicated unit that is part of the building's main system. The unit shall maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, or the current ASHRAE recommendations at the time of construction.
    b. The HVAC load shall be designed to displace a minimum of 12KW of power, or 3.5 Tons, and shall be designed to load, if the known load is greater at the time of design.
    c. It is recommended that the Building MDF maintain the stated temperature and humidity in the event of building power outages or primary HVAC system failure.
    d. Air delivery shall be aligned in the front of the equipment rows and returns at
    e. the rear of the equipment rows.
4. Lighting (Building MDF)
    a. Fluorescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended. Lighting shall be a minimum of 50-foot candles measured at 3 feet above the floor in the entire space.
    b. The Building MDF shall be equipped with emergency lighting to keep the space lit during power outages.
5. Power (Building MDF)
    a. Power for the Building MDF shall be in two categories: dedicated and convenience.
    b. Dedicated
        1) The Building MDF shall be equipped with (2) dedicated 208 volt 3-phase 150 Amp circuits, 4-wire (2PH + N +G), hardwired to the UPS(s). The originating

electrical panel will be equipped with (2) 150 AMP breakers. Conductors shall be routed from the panel in conduit to the UPS wiring terminals.

2) The Building MDF shall be equipped with a minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load. An additional circuit and space is allocated should the load exceed 16kVA and a second UPS be required.

3) Additional power circuits to be allocated to security, fire alarm, CATV, building controls, and service provider equipment shall be considered and coordinated at the time of building design.

4) Power distribution to the racks and cabinets shall be achieved by installing PDUs which are not within the scope of this document and are to be provided by the Alamo Colleges network department.

c. Convenience

1) The Building MDF shall be equipped with 20 Amp Duplex NEMA 5-20R receptacles, with maximum (6) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.

2) A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) Duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.

6. Racks and Cable Management (Building MDF)

a. The Building MDF shall be equipped with (4) Standard Equipment Racks.

1) Each rack shall be equipped with a vertical cable manager on both sides of the rack. Adjacent racks may share a vertical wire manager between them.

2) Each rack shall be equipped with a horizontal wire manager above and below each horizontal patch panel.

b. The Building MDF shall be equipped with (1) Server Cabinet. The fronts of the cabinets shall face the row of equipment racks.

1) Space shall be allocated for an additional (3) future Server Cabinets.

a) Cabinets shall be bayed together with sides removed when mounted adjacently.

2) Wall space at the back of the Building MDF shall be allocated for service provider equipment.

c. The Building MDF shall be equipped with cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (2) times.

1) Cable runway shall attach to the tops of Standard Equipment Racks utilizing rack-to-runway hardware kits.

2) Cable runway shall suspend above Server Cabinets and be supported overhead by all thread to the building structure utilizing manufacturer- approved hardware and methods.

3) A vertical section of cable runway shall be attached to the wall board to manage backbone and service provider cables as they transition from the entrance conduits to the overhead cable runway.

C. IDF-1 and IDF-2

1. Description

a. IDF-1

1) An IDF-1 is a Telecommunications space that resides in each building that is part of a multi-building campus. There is only (1) in each building that is part of a multi-building campus (other than the building housing the Campus MDF.)

2) An IDF-1 houses the entrance conduits, terminations, and cross connections for all incoming inter-building cabling from the Campus MDF and all intra-building backbone cabling from the IDF-2s of the building in which it resides.

3) An IDF-1 houses the terminations and cross connections for the horizontal user workstation cabling in the area of the building that it serves.

4) An IDF-1 does not exist in a single stand-alone building.

b. IDF-2

1) An IDF-2 is a Telecommunications space that resides in each building that requires more than a single closet from which to terminate horizontal workstation cables. There may be multiple IDF-2s in each building as required to maintain horizontal cable distances of 295 feet for the permanent link.

2) An IDF-2 houses the terminations, and cross connections for all incoming intra-building cabling from the MDF or IDF-1 of the building in which it resides.

3) An IDF-2 houses the terminations and cross connections for the horizontal user workstation cabling in the area of the building that it serves.

c. Building workstation access network equipment will reside in the IDFs.

d. The IDF may share space with other systems such as security panels, CATV cabling, and paging system cabling.

e. The IDF shall not be used for storage, serve as a mechanical or electrical distribution space, nor shall it have within its space main electrical feeds, water or main sprinkler lines.

f. The layout of racks, wall fields, and cable management shall be as indicated on the attached diagrams.

2. Architectural (IDF-1 and IDF-2s)

a. The IDF shall be a minimum of 108 square feet with minimum clear lineal wall lengths of at least 9 feet by 12 feet; all walls shall go to deck.

b. Floor finish shall be bare concrete. Windows are not recommended.

c. IDFs shall be arranged in a stacked formation in multi-story buildings, and not be located near sources of EMI and mechanical vibration.

d. All walls of the IDF shall be covered with AC Grade ¾" Fire Retardant Plywood, aligned vertically starting at 12 inches above the finished floor. The plywood shall not be painted. Contractor sall ensure fire-rated stamp is not painted or covered.

e. The room shall be without a ceiling.

f. Entry to the space shall be through a minimum 36-inch by 80-inch clear door opening that swings outward. Door shall be solid core or steel with shatter- proof window if equipped. The door shall securely lock and access shall only be by Alamo Colleges-approved personnel.

g. When an access control security system is available, the entrance to the IDF shall be equipped with a proximity card reader and electrified door hardware. When a surveillance system is available an IDF shall be equipped with at least (1) camera.

3. HVAC (IDF-1 and IDF-2s)
   a. The IDF shall be serviced by the building HVAC system and be equipped with Split DX system through the wall above the door which cools only when the building HVAC is inadequate or not running. The system or unit shall maintain a constant 24/7 cooled environment between 68° and 75° F with a humidity of 40% to 55%.
   b. The minimum HVAC load shall be designed to displace 2KW of power, or 0.6 of a Ton, and be designed to load if the load is greater and known at the time of design.
4. Lighting (IDF-1 and IDF-2s)
   a. Fluorescent light fixtures shall be at least 12 inches above the top of the highest rack or cable runway, 18 inches is recommended. Lighting shall be a minimum of 40-foot candles at 2 feet above the floor in the entire space.
5. Power (IDF-1 and IDF-2s)
   a. Power for the IDF shall be in two categories: dedicated and convenience.
   b. Dedicated
      1) The IDF shall be equipped with (2) dedicated 120 volt 20 Amp circuits, each with a simplex NEMA L5-20R receptacle. The originating electrical panel will be equipped with 20 AMP breakers. Conductors shall be routed from the panel in conduit along the cable runway to a metallic back box clipped to the rail of the Cable Runway, facing the rear of the racks.
      2) The IDF shall be equipped with (1) APC Symmetra SmartUPS 2200 SUA2200R2X106 with a single NEMA L5-20P power cord to provide 5 minutes of run time at full load.
      3) Additional power circuits to be allocated to security and CATV shall be considered and coordinated at the time of building design.
      4) Power distribution shall be achieved by the installation of PDUs which are outside the scope of this document and furnished by the network department.
   c. Convenience
      1) The IDF shall be equipped with 20 Amp Duplex NEMA 5-20R receptacles, maximum (6) per circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.
      2) A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) Duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.
6. Racks and Cable Management (IDF-1 and IDF-2s)
   a. The IDF shall be equipped with (2) Standard Equipment Racks.
      1) Each rack shall be equipped with a vertical cable manager on both sides of the rack. Adjacent racks may share a vertical wire manager between them.
      2) Each rack shall be equipped with a horizontal wire manager above and below each horizontal patch panel. An equal number of horizontal wire managers

shall be furnished for the network switches and installed as directed by the owner.

a) Space shall be reserved for an additional rack and vertical wire manager

b) A third rack and vertical wire manager shall be installed in IDFs that serve equipment racks located in Lab(s).

b. The IDF shall be equipped with cable runway encircling the room at 90 inches above the finished floor, and crossing the room parallel to the rack rows (1) time.

1) Cable runway shall attach to the tops of Standard Equipment Racks utilizing rack-to-runway hardware kits.

2) A vertical section of cable runway shall be attached to the wall board to manage backbone cables as they transition from floor sleeves to the overhead cable runway.

6.2 Entrance Pathways and Conduits

A. Design Principles

1. Pathways and conduits are described herein with regard to capacity, function, and basic design principles and shall be designed by the MEP in accordance with NEC and EIA/TIA-758, Customer Owned Outside Plant Telecommunications Cabling.
2. Telecommunications Conduit Systems shall:
   a. Contain no more than the equivalent (2) 90 degree bends between pull boxes.
   b. Maintain a minimum bend radius of 10 times the diameter of the conduit.
   c. Not exceed 40 percent fill ratio for multiple cables.
   d. Be placed at a minimum depth of 24 inches from the top of the conduit to the finished grade.
   e. Be interrupted by an adequately sized pull box at least every 600 feet for sections containing up to (1) 90 degree of bend, and at least every 350 feet for sections with the equivalent of (2) 90 degree bends.
      1) Pull boxes shall be of adequate depth for conduits to enter from the side of the pull box and not be required to sweep up into the box.
   f. Stub up into the MDF between 1 and 3 inches above the finished floor.
   g. Contain a pulling tape, be fitted with bushings, and sealed appropriately at both ends.

B. Service Provider Conduits

1. Minimum of (4) 4-inch conduits shall route underground from the MDF to the edge of the property Right of Way and terminate as required by the service provider. Additional conduits shall be added as required.
2. Manholes and pull boxes shall be utilized as required for a telecommunications- compliant conduit distribution system.
3. Where the service provider termination location is unidentified at the time of design, the conduits shall route from the MDF to an adequately-sized pull box or manhole at least 30 feet from the building edge.

C. Campus Serving Conduits
1. Minimum of (2) 4-inch conduits shall route underground from the Campus MDF to the IDF-1 of each additional building on the campus. Additional conduits shall be added as required if fill capacity exceeds 40 percent.
2. Manholes and pull boxes shall be utilized as required for a Telecommunications- compliant conduit distribution system.
3. Where only the first building of a campus is being designed, two (2) 4-inch conduits for each additional future building shall route from the campus MDF to an adequately-sized pull box or manhole at least 30 feet from the building edge.

D. Building Entrance for Large Campus
1. For large campuses, the MEP and Structural Engineer shall consider a conduit entrance vault as part of the Campus MDF sub floor.

6.3 Cable Management in Telecommunications Spaces

A. Racks
1. Racks shall be black aluminum Standard Equipment Racks with EIA 19-inch rails, 84-inch (45 RMU) overall height, 3-inch rail depth, dual floor mounting flanges, and rack mount unit markings engraved on the rails.
2. Racks shall be bolted to the concrete floor and the overhead cable runway utilizing manufacturer-recommended hardware and methods.

B. Server Cabinets
1. Server Cabinets shall be 24 inches by 42 inches by 84 inches with adjustable front and rear EIA 19” rail kits, enclosed with ventilated front and rear locking doors, adjustable leveling feet, vertical cable manager for one rail, and grounding kit.
2. Cabinets shall be set directly on the finished floor but not bolted unless set on a raised floor. Adjacent cabinets shall be bayed together with the sides removed.

C. Overhead Cable Management
1. Overhead Cable Management shall be 18-inch (MDF) or 12-inch (IDF) Universal Cable Runway made of 3/8” x 1-1/2” x .065” wall rectangular steel tubing with cross members welded at 12-inch intervals.
   a. Cable Runway shall be installed utilizing appropriate hardware to support, join, or attach sections to structures, and shall be supported at a minimum of 5 foot intervals.

D. Vertical Cable Managers
1. Vertical cable managers shall be black double-sided, 6 inches wide, 12.75 inches deep, and 84 inches tall, no doors, and include formed cabling sections, lockable cabling latches at 12- inch intervals, and protective edge guards.
   a. Bolt vertical cable managers to the racks with included hardware kit.

E. Horizontal Cable Managers.

1. Attach horizontal cable managers to the rack rails with included screws.
2. Contractor shall provide managers above and below each patch panel and sufficient managers for additional owner provided LAN Switches. For each horizontal patch panel, the contractor shall provide 1 horizontal cable manager for LAN switches.

6.4 Cable Support in Pathways

A. Main Cable Pathway

1. Main cable pathway shall be designed by the MEP, shown on the electrical drawings, and be installed by the Division 26 electrical contractor. Cable Tray shall be Electro Zinc Wire Mesh Basket Tray, minimum 12 inches wide by 2 inches tall; size shall be scaled to the application not to exceed 40 percent fill ratio.
2. Basket Tray shall be installed utilizing appropriate hardware to support, join, or attach sections to structures, shall be supported at a minimum of 5-foot intervals, and grounded as a single-conductor system. Tray manufacturer recommendations shall be followed.

B. Sleeves and Penetrations and EZ Path

1. Sleeves and Penetrations are described herein with regard to capacity, function, and basic design principles and shall be designed by the MEP in accordance with NEC and EIA/TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces.
2. All sleeves shall be equipped with nylon bushings.
3. Scale the quantities of sleeves to maintain a 40 percent fill ratio (or less) in each sleeve.
4. Above MDFs or IDFs install minimum of (4) 4" EMT sleeves through the partition wall between the MDF or IDF overhead space and the main cabling pathway.
5. Between directly aligned vertically stacked MDF and IDFs install minimum of (2) 4" EMT sleeves into bored penetrations through the upper floor structure.
6. Between slightly skewed vertically stacked MDF and IDFs install minimum of (2) continuous 4" EMT conduits from the outside wall of the upper to the outside wall of the lower IDF.
7. Between completely skewed MDFs and IDFs on adjacent floors, install minimum of (2) 4" EMT sleeves through the floor the upper IDF into the accessible ceiling space below and utilize above-ceiling pathways to route cabling into the IDF or MDF on the lower floor.
    a. Pathways thru Fire rated walls of each MDF & IDF shall be STI EZ Path cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall: Meet the hourly fire-rating of fire rated wall and or floor penetrated.
    b. Be tested for the surrounding construction and cable types involved.
    c. Have UL Systems permitting cable loads from; "Zero to 100% Visual Fill." This requirement eliminates the need for fill-ratio calculations to be made by cable technicians to ensure cable load is within the maximum allowed by UL System.
    d. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.

e. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
f. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
g. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
h. Cable Pathway Devices passing vertically through floors shall have equal F & T Rating. (See UL System # F-A-3037, Item #4 "EZ-PATH Grid T-Rating Kit" Part # TRK444)
i. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

C. Workstation Rough-ins and local power
1. At each wall-mounted workstation location, install a 4 inch by 4 inch by 2-1/8 inch double-gang back box with double-gang mud ring at 18 inches above the finished floor, at 42 inches for emergency wall phones, 6 inches below the ceiling grid for wireless access points and IP cameras, and at appropriate height for above- counter and millwork locations.
a. Install a 1-inch conduit from the rough-in box to the cable tray.
b. Terminate the conduit above the edge of the cable tray and install nylon bushings and pull string, the conduit is not required to be bonded to the cable tray.
1) Conduit shall be installed in accordance with EIA/TIA-569-B, contain no more than the equivalent of (2) 90 degree bends and or 98.4 feet between pull boxes, and maintain a bend radius of 6 times the diameter of the conduit.
2. At floor-mounted workstation locations, install a floor box or poke-thru specifically designed for the application and environment adequately sized to accommodate the quantity of installed horizontal data cables.
a. Install (1) 1 inch conduit for every (6) cables from the floor box to the cable tray.
1) For poke-thrus, route the conduit to the cable tray in the floor below.
2) Floor-mounted outlets should be avoided and all other possible design solutions shall be considered.
3. For modular furniture workstations, a rough-in pathway shall be considered and designed according to the furniture type, quantity of cables, and location as required for each furniture system.
a. The use of power poles shall be considered only on a case-by-case basis.
4. For above ceiling-mounted outlets such as Wireless Access Points or IP Cameras, no rough-in is required, the data cable will terminate into a surface- mount box secured to the structure above the ceiling grid. Install cable outlet ID on ceiling grid within 3' of the outlet in the ceiling.
5. The electrical engineer shall design at a minimum (1) duplex NEMA 5-15R receptacle within 18" of each workstation outlet location.

6.5 Backbone Cabling

A. Inter-building Backbone Cabling (Campus)

1. Copper

a. Inter-building Backbone Copper Cabling shall be 50-pair PE-39 24 AWG flooded UTP from the Campus MDF to the IDF-1 in each of the buildings on the campus. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Provide a 30-foot service loop in each manhole or pull box. Cables shall be secured with Hook-and-loop Velcro tie-wraps in the MDF or IDF.

b. Inter-building Backbone Copper Cabling shall terminate on UL-listed 50-pair 110 IDC in/out lightning protection panels equipped with UL-listed 5-pin solid state quick-acting protector modules. The secondary side of the panel shall be connected to a 50-Pair 110 Block with legs. Panels and blocks shall be wall mounted.

2. Fiber

a. Inter-building Backbone Fiber Optic Cabling shall be loose tube outdoor- rated composite 12-Strand Single Mode / 24-Strand 50 micron OM3 (up to 300 meters) or OM4 (over 300 meters) Multi Mode from the Campus MDF to the IDF-1 in each of the buildings on the campus, installed in 1-inch outdoor- rated innerduct, and dressed with fan-out kits as required. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Provide a 30-foot service loop in each manhole or pull box. Cables shall be secured with Hook-and- loop Velcro tie-wraps in the MDF or IDF.

b. Terminate all strands of each fiber optic cable on LC connectors. Connect terminated LC connectors to the back of coupler panels placed into 19 inch rack-mounted fiber optic termination housings.

B. Intra-Building Backbone Cabling

1. Copper

a. Intra-building Backbone Copper Cabling shall be 25-pair Category 3 plenum rated 24 AWG UTP from the MDF or IDF-1 to each of the IDF-2s in the building. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Cables shall be secured with Hook-and- loop Velcro tie-wraps in the MDF or IDF.

b. Intra-building Backbone Copper Cabling shall terminate on a 110 Block with legs; blocks shall be wall mounted.

2. Category 6A Network Uplinks

a. Category 6A network uplinks shall be (2) Category 6A UTP plenum rated blue sheath, between the Special Systems patch panels in MDF and IDFs on adjacent floors that are vertically stacked, and between IDF-2s on the same floor, where the permanent link of the Category 6A cable does not exceed 314 feet (allowing a total of 14' of patch cables while not exceeding a 328' channel length).

3. Fiber

a. Intra-building Backbone Fiber Optic Cabling shall be tight buffered plenum- rated composite 6-Strand Single Mode / 12-Strand 50 micron OM3 (up to 300 meters) or

OM4 (over 300 meters) Multi-Mode, encased in orange interlocking armor. Provide a 10-foot service loop at both ends of each cable stored on the wall above or below the cable runway. Cables shall be secured with Hook-and-loop tie-wraps in the MDF or IDF and in the cable tray.

b. Terminate all strands of each fiber optic cable on LC connectors. Connect terminated LC connectors to the back of coupler panels placed into 19-inch rack-mounted fiber optic termination housings.

6.6 Horizontal Cabling

A. Workstation Cable

1. Horizontal Data Cabling shall be Category 6/6A UTP, minimum factory sweep tested to 550 MHz, plenum rated, blue sheath, installed from the patch panel in the MDF or IDF to the workstation location not to exceed 295 feet for the permanent link. Provide a 10' service loop in the MDF or IDF, and 1-foot of slack behind the faceplate. Cable bundles shall be secured with Hook-and- loop Velcro tie-wraps in the MDF or IDF and in the cable tray.
2. At the workstation, each Category 6/6A cable shall be terminated in a gray Category 6/6A modular jack insert and snapped into a 2-gang, furniture, floor box or poke-thru faceplate. Faceplates shall be equipped with desi-windows for labeling and blank inserts in unused ports. Wall phone workstations shall be equipped with a studded wall phone faceplate capable of accepting a modular jack insert. All faceplate colors shall be coordinated with the Architect or owner at the time of installation.
3. In the MDF or IDF, each Category 6/6A cable shall be terminated on the back of Category 6/6A 48-port IDC patch panels which are mounted in the 19-inch racks.
4. Category 6/6A cable shall be terminated with the EIA-568B sequence.
5. Horizontal cabling shall be manufactured by:
   a. BerkTek
   b. General
   c. Hitachi

B. Patch Panels

1. Horizontal cables shall be terminated at the MDF/IDF rooms on high-density integrated patch panels incorporating Category 6/6A jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet detailed in the section above.
2. Patch panel configuration shall be 48 ports.
3. Standard Data Cable patch panel shall exceed ANSI/TIA/EIA 568-C.2-1 Category 6/6A component compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.
4. Special Systems (WAP & Uplink) Data Cable patch panel shall exceed ANSI/TIA/EIA 568-C.2-1 Category 6A component compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.
5. The patch panels shall be interoperable and backwards compatible to lower performing cabling systems.

6. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers' minimum bend radius specifications are adhered to.
7. The patch panel shall have color-coded designation strips to identify cable count.
8. Patch panels shall be manufactured by Leviton.

C. Patch Cords
1. In each MDF or IDF, furnish to the owner at the time of final inspection (1) Category 6 modular non-booted patch cord for each terminated horizontal data cable plus 25 percent, 50 percent of the total quantity shall be blue and the other 50 percent shall be green in the following proportions:
   a. Blue – Cat 6 [Standard data/phone]
      1) 33% 7-foot
      2) 33% 10-foot
      3) 33% 14-foot
   b. Green – Cat 6 [Standard data/phone]
      1) 33% 7-foot
      2) 33% 10-foot
      3) 33% 14-foot
   c. Yellow - Cat 6A [Wireless APs)
      1) Two (2) 7-foot for each WAPs
   d. Red – Cat 6 [Fire Alarm or Security Equipment]
      1) Two (2) 10-foot for each cable installed
   e. Orange – Cat 6A [Copper Backbone Uplinks]
      1) Four (4) 7-foot for each IDF
2. For outlets, furnish to the owner at the time of final inspection (1) Category 6 modular non-booted patch cord for each terminated horizontal data cable plus 25 percent, 50 percent of the total quantity shall be blue and the other 50 percent shall be green in the following proportions:
   a. Blue – Cat 6
      1) 50% 10-foot
      2) 50% 14-foot
      3) Black
      4) 50% 10-foot
      5) 50% 14-foot
3. Fiber optic patch cables shall be furnished by the ITS Network Department.

D. Workstation Configurations (data outlets)
1. Modular Jack
   a. Data jacks shall be non-keyed 8-pin modular jacks.
   b. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
   c. Jacks shall utilize a four-layer printed circuit board to control NEXT.
   d. Jack housings shall fully encase and protect printed circuit boards and IDC fields.

e. Modular jack contacts shall accept 2500 plug insertions.
f. Modular jack contacts shall be formed flat for increased surface contact with mated plugs. These contacts shall be arranged on the PC board in two staggered arrays of four to maximize contact spacing and minimize crosstalk.
g. Jacks shall terminate 22-26 AWG stranded or solid conductors.
h. Jacks shall terminate insulated conductors with outside diameters up to.050".
i. Jacks shall be compatible with EIA/TIA 606 color code labeling and accept snap on icons for identification or designation of applications.
j. Jacks shall be marked as either T568A or T568B wiring.

2. Category 6/6A jacks shall be manufactured by Leviton.

E. Office Workstation
1. Install (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.
a. Furnish a minimum of (1) 2-port workstation on each of (3) walls in each office.
b. Modular furniture clusters shall be designed to accommodate the user requirements at the time of construction.
2. Category 6 jacks shall be manufactured by Leviton to match District standards

F. Classroom Instructor Workstation
1. Install (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.
2. Furnish a minimum of (2) 2-port instructor workstations in each classroom oriented in the front and back of each room.
3. Category 6 jacks shall be manufactured by Leviton to match District standards

G. High-Density Workstation
1. Install up to (6) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.
2. Category 6 jacks shall be manufactured by Leviton to match District standards

H. Emergency Wall-Phone Outlet
1. Install (2) Category 6 cables terminated on a gray jack insert into a double gang faceplate mounted at the Architect's designated height for emergency phones
2. Category 6 jacks shall be manufactured by Leviton to match District standards. Ceiling-mounted Projector Outlet

I. Install (2) Category 6 cables terminated on a gray jack insert into a single gang faceplate at the projector plate.
1. Category 6 jacks shall be manufactured by Leviton to match District standards

J. Wireless Access Point Outlet

1. Install (2) Category 6A cables with 20-foot slack loops at each workstation, terminated on gray jack inserts into a double gang flush faceplate or surface mount box secured to the building structure when mounted above the ceiling.
2. When a Wireless Access Point workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.
3. At the time of construction, the designer shall take into account the user requirements for wireless coverage and include a sufficient quantity of WAP workstations to enable said coverage.

K. IP Camera Outlet
1. Install (2) Category 6 cable with 20-foot slack loop at each workstation, terminated on a gray jack insert into a double gang flush faceplate or surface mount box when mounted above the ceiling.
2. When a Wireless Access Point workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.
3. The designer shall coordinate with the security engineer to determine quantities and locations of IP Cameras.

L. Emergency Stanchion (Blue Light/Phone)
1. Install (1) Category 6 4-pair voice-grade PE-39 flooded 22 AWG UTP cable from the closest MDF or IDF to each stanchion-mounted blue light phone location. Terminate the cable on a 4-pair lighting protection module at each end.

6.7 Grounding

A. Grounding shall be designed and installed in accordance with ANSI-J-STD-607-A.

B. Install a Telecommunications Main Grounding Busbar (TMGB) (per building) in the MDF and IDF-1s, and a Telecommunications Grounding Busbar (TGB) in each IDF-2.

C. Install a Telecommunications Bonding Backbone (TBB), #3/0 AWG stranded green insulated copper conductor in a star topology between the TMGB and each TGB in each building. When IDFs are stacked a single TBB can be daisy-chained between TGBs back to the TMGB.

D. Install an Equipment Bonding Conductor (EBC), #6 AWG green insulated conductor from the TMGB or TGB as applicable to each cable runway system, equipment rack, cabinet, lightning protector, or multi-pair cable with a metallic element.
1. Install a #3/0 AWG stranded green insulated copper conductor from the TMGB to the main building electrical service ground in each building.
2. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TGB and TMGB shall be bonded to the vertical steel

metal frame using a minimum #6 AWG conductor. The connection to building steel does not eliminate the requirement for the TBB or BC to the service ground.

E. Install a Grounding Equalizer Conductor, #3/0 AWG stranded green insulted copper conductor to interconnect multiple TBBs on the top floor and every 3rd floor when required by ANSI J-STD-607-A.

F. When exceeding 13 feet the conductors shall be sized at 2 kcmil per linear foot of conductor length up to a maximum of 3/0 AWG.

6.8 Labeling

A. Verify room numbers and confirm the final room numbering scheme prior to generating labels.

B. Backbone Fiber and Copper Cables shall be labeled within 12 inches of the visible end of the jacket.

C. Fiber Innerduct shall be labeled within 12 inches of the point of entry of the fiber optic enclosure.

D. Cables shall be labeled identically at both ends.

E. MDFs and IDFs Room shall be labeled (signage) with the permanent room designations that match the final building signage for cable labeling.

F. Equipment racks in each MDF or IDF shall be labeled in sequential numeric order. Labels shall be centered on the top front of the equipment rack.

G. Fiber optic backbone cable labels shall contain the cable origin room number, the cable destination room number, fiber strand numbers, and type (i.e. MDFA150-IDFC126- 50MM001-024/SM001-012).

H. Fiber optic enclosures shall be labeled alpha-numeric starting with the 1st fiber optic enclosure in the top of the 1st equipment rack. A label for each terminated strand shall be securely placed inside each fiber optic enclosure.

I. Fiber optic couplers panels in fiber enclosures shall be labeled at each end by strand denoting MDF and/or IDF the cable comes from, and Strand number to and from respectively (i.e. IDFC126-50MM001-012).

J. Copper backbone cable labels shall contain the cable origin room number, the cable destination room number, and cable pairs (i.e. MDFA150-IDFC126/001-025).

K. Patch panels in each closet shall be uniquely alphabetically labeled sequentially starting with the first Patch Panel in the top of the first equipment rack (i.e. A, B, C, D, E, etc.). Each MDF or IDF starts with A and shall not repeat a letter. Any MDF/IDF room with more than 26 patch panels shall start with AA,BB,CC…

L. 110-type blocks shall contain the origin room number, destination room number, and pair numbers, under each pair termination. (i.e. MDFA150-IDFC126-PR 1-25). 110- type block labels shall be printed on product-specific label strips and placed into label holders.

M. Workstation Faceplates shall be labeled denoting origin MDF/IDF Room Number, patch panel, and port number (i.e. IDFC126-B5).
   1. When a Wireless Access Point or IP Camera workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.

6.9 Testing

A. Terminated fiber optic strands shall be tested bi-directionally end to end be and certified in accordance with applicable industry standards with a light meter and OTDR field tester(s) that are within their calibration period.

B. Terminated backbone copper cable links shall be tested in accordance with applicable industry standards for attenuation, continuity, and pin-mapping with approved field tester(s) that are within their calibration period.

C. Terminated Category 6/6A UTP cable shall be tested as a Permanent Link in accordance with applicable industry standards for Category 6 compliance with approved field tester(s) that are within their calibration period.

6.10 As-Built Documentation

A. Produce drawings depicting the condition of the Structured Cabling System as installed produced in AutoCAD 2007 or higher and provided in hardcopy, electronically in .DWG and .PDF format, and a laminated set in each MDF or IDF-1. Include the exact dimensions and locations of MDF and IDF layouts, wall elevations, equipment rack elevations, cable runways, cable tray, sleeves, backbone and horizontal cable pathways, workstation locations, and numbering and labeling scheme.

B. Produce cable records for the Structured Cabling System as installed to include a list of all horizontal and backbone cables produced in an Excel format and provided in hardcopy and electronic format indicating cable number, unique cable label, cable type, origin and destination, length, termination method, and pass/fail result.

C. Produce (3) hard copies of all test results for each cable, to include technician's name and date stamp, a list of tested cables, and the individual results for each cable tested. Test results shall be furnished on CD ROM to include native file format and .PDF format.

PART 7 - Summary and Synopsis 0f Standards

7.1 Summary

A. All aspects of this Alamo Colleges Telecommunications Infrastructure Standards shall be applied to the design process for both new and renovated facilities.

B. A Division 27 10 00 specification and T-Series drawings shall be commissioned and issued by the Architect during the design phases for each facility or project.

C. Facility Standards

SPACE	CAMPUS MDF	BUILDING MDF	IDF-1 AND IDF-2
ARCHITECTURAL	**Minimum of 600 square feet, minimum clear lineal wall length 30 feet, walls to deck, floor sealed bare concrete, no windows, exterior wall within 50 feet of building exterior, not be located adjacent to or below restrooms or other water-based facilities, or sources of EMI and mechanical vibration, all walls covered with plywood, without a ceiling or a lift-out tile ceiling, minimum 42-inch by 80-inch clear door opening, door not open to the exterior of the building, proximity card reader and electrified door hardware, sprinkler system, consider pre-action.**	**Minimum of 400 square feet, minimum clear lineal wall length 25 feet, all walls to deck, floor sealed bare concrete, no windows, exterior wall that is within 50 feet of the building exterior, not be located adjacent or below restrooms or other water-based facilities, or sources of EMI and mechanical vibration, all walls covered with plywood, without a ceiling or a lift-out tile ceiling, minimum 42-inch by 80-inch clear door opening, door not open to the exterior of the building, proximity card reader and electrified door hardware, sprinkler system, consider pre-action.**	**Minimum of 108 square feet, minimum clear lineal wall lengths of at least 9 feet by 12 feet, all walls to deck, floor sealed bare concrete, windows are not recommended, IDFs shall be arranged in a stacked formation in multi-story buildings, and not be located near sources of EMI and mechanical vibration, all walls covered with plywood, the room shall be without a ceiling, minimum 36-inch by 80- inch clear door, proximity card reader and electrified door hardware.**
HVAC	**Dedicated unit that is part of the building's main system, maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, minimum HVAC load shall be designed to displace 20KW of power, or 6 Tons, maintain temp and humidity in the event of building power outages or main unit failure.**	**Dedicated unit that is part of the building's main system, maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 41.9°F Dew Point to 60% RH and 59°F Dew Point, minimum HVAC load shall be designed to displace 12KW of power, or 3.5 Tons, maintains temp and humidity in the event of building power outages or main unit failure.**	**Serviced by the building HVAC system and equipped with Split DX system that cools only when the building HVAC is inadequate, maintain a constant 24/7 cooled environment between 68° and 75° F with humidity of 40% to 55%, minimum HVAC load shall be designed to displace 2KW of power, or 0.6 of a Ton.**

LIGHTING	**Minimum of 50 foot candles at 2 feet above the floor in the entire space. Equipped with emergency lighting to keep the space lit during power outages, fixtures 18 inches above top of the highest rack or cable runway.**	**Minimum of 50 foot candles at 2 feet above the floor in the entire space. Equipped with emergency lighting to keep the space lit during power outages, fixtures 18 inches above top of the highest rack or cable runway.**	**Minimum of 40 foot candles at 2 feet above the floor, fixtures 18 inches above top of the highest rack or cable runway. Equiiped with emergency lighting.**
POWER	**(2) dedicated 208 volt 3- phase 150 Amp circuits, 4- wire (2PH + N +G), hardwired to the UPS(s), originating electrical panel will be equipped with (2) 150 AMP breakers, minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to provide 30 minutes of run time at full load.**	**(2) dedicated 208 volt 3- phase 150 Amp circuits, 4- wire (2PH + N +G), hardwired to the UPS(s). The originating electrical panel will be equipped with (2) 150 AMP breakers, minimum of (1) APC Symmetra LX 16kVA Scalable to 16kVA N+1 Ext. Run Tower, 208/240V, to**	**(2) dedicated 120 volt 20 Amp circuits, each with a simplex NEMA L5-20R receptacle. The originating electrical panel will be equipped with 20 AMP breakers. Conductors shall be routed from the panel in conduit along the cable runway to a metallic back box clipped to the rail of**
	A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter, minimum of (1) Duplex receptacle shall be placed in each wall.	**provide 30 minutes of run time at full load. A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter, minimum of Duplex receptacle shall be placed in each wall.**	**the Cable Runway, facing the rear of the racks, minimum (1) APC Symmetra SmartUPS 2200 SUA2200R2X106 with a single NEMA L5- 20P power cord to provide 5 minutes of run time at full load. A Duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter, minimum of (1) Duplex receptacle shall be placed in each wall.**

RACKS AND CABLE MANAGEMENT	(4) Standard Equipment Racks, vertical cable manager on both sides of the rack, horizontal wire manager above and below each horizontal patch panel. (2) Server Cabinets, space shall be allocated for an additional (7) future Server Cabinets. Space equivalent to (2) Server Cabinets shall be allocated for service provider equipment. Cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (3) times, vertical section of cable runway from the entrance conduits to the overhead cable runway.	(4) Standard Equipment Racks, vertical cable manager on both sides of the rack, horizontal wire manager above and below each horizontal patch panel. (1) Server Cabinet, space shall be allocated for an additional (3) future Server Cabinets. Wall space at the back of the Building MDF shall be allocated for service provider equipment. Cable runway encircling the room at 86 inches above the finished floor, and crossing the room parallel to the rack rows (2) times, vertical section of cable runway from the entrance conduits to the overhead cable runway.	(2) Standard Equipment Racks, vertical cable manager on both sides of the rack, horizontal wire manager above and below each horizontal patch panel, an equal number of horizontal wire managers shall be furnished for the network switches. Space reserved for additional rack and vertical wire manager, a third rack and vertical wire manager IDFs that serve equipment racks located in Lab(s). Cable runway encircling the room at 84-86 inches above the finished floor, and crossing the room parallel to the rack rows time, vertical section of cable runway from floor sleeves to the overhead cable runway.

TECHNOLOGY	STANDARDS
ENTRANCE PATHWAYS AND CONDUITS	Service Provider Conduits; Minimum of (4) 4-inch conduits from the MDF to the edge of the property Right of Way. Campus Serving Conduits: Minimum of (2) 4-inch conduits shall route underground from the Campus MDF to the IDF-1 of each additional building on the campus. Building Entrance for Large Campus: MEP and Structural Engineer shall consider a conduit entrance vault.
CABLE MANAGEMENT IN TELECOM SPACES	Racks black aluminum Standard Equipment Racks with EIA 19-inch rails, 84-inch (45 RMU) overall height, 3-inch rail depth, dual floor mounting flanges, and rack mount unit markings engraved on the rails. Server Cabinets 24 inches by 42 inches by 84 inches with adjustable front and rear EIA 19" rail kits, enclosed with ventilated front and rear locking doors, adjustable leveling feet, vertical cable manager for one rail, and grounding kit. Overhead Cable Management 18-inch (MDF) or 12-inch (IDF) Universal Cable Runway made of 3/8" x 1-1/2" x .065" wall rectangular steel tubing with cross members welded at 12 inch intervals. Vertical cable managers black double-sided, 6 inches wide, 12.75 inches deep, and 84 inches tall, no doors, and include formed cabling sections, lockable cabling latches at 12-inch intervals, and protective edge guards. Horizontal cable managers black double-sided, 19 inches wide, 11.73 inches deep, and 2 RMU, cable guide fingers at 1.75" intervals, flanged pass-through slots, and snap-on, hinged door/cover.

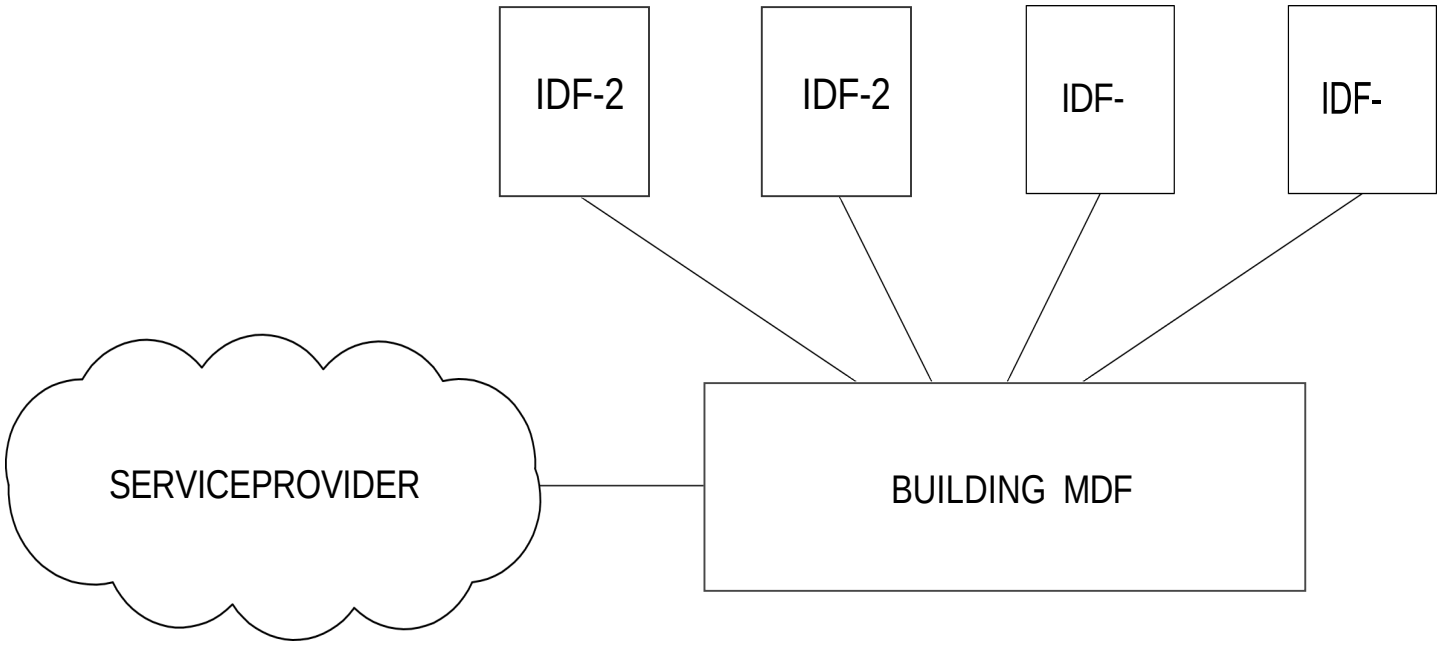
CABLE SUPPORT IN PATHWAYS AND LOCAL POWER	Main cable pathway support shall be Electro Zinc Wire Mesh BasketTray Above MDFs or IDFs install minimum of (4) 4" EMT sleeves through the partitionwall. Between MDF and IDFs install minimum of (2) 4" EMT sleeves Wall-mounted workstation location, double-gang back box with double-gang mud ring,1-inch conduit from the rough-in box to the cable tray, terminate the conduit above the edge of the cable tray, conduit not required to be bonded to the tray. At floor-mounted workstation locations (1) 1 inch conduit for every (6) cables from the floor box to the cable tray. For poke-thrus, route the conduit to the cable tray in the floor below. For modular furniture workstations, a rough-in pathway shall be considered and designed according to the furniture type, quantity ofcables, and location as required for each furniture system. The electrical engineer shall design a duplex NEMA 5-15R receptacle within 18" of each workstation outlet location. EZ Path Sleeves or Fire rated cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints
INTER-BUILDING BACKBONE CABLING	Copper Cabling 50-pair PE-39 24 AWG flooded UTP from the Campus MDF to the IDF-1 in each of the buildings on the campus, terminate on lightning protection and 110blocks Fiber Optic Cabling loose tube outdoor-rated composite 12-Strand Single Mode / 24-Strand 50 micron OM3 Multi Mode from the Campus MDF to the IDF-1 in each of the buildings on the campus, installed in 1-inch outdoor-rated innerduct, terminate with LC connectors.
INTRA-BUILDING BACKBONE CABLING	Copper Cabling 25-pair Category 3 plenum rated 24 AWG UTP from the MDF or IDF-1 to each of the IDF-2s in the building, terminate on 110 blocks. Category 6A network uplinks (2) Category 6 UTP plenum rated blue sheath, between the Special Systems patch panels in MDF and IDFs on adjacent floors that are vertically stacked, and between IDF-2s on the same floor, where the permanent link of the Category 6A cable does not exceed 328 feet. Fiber Optic Cabling shall be tight buffered plenum-rated composite 6-Strand Single Mode / 12-Strand 50 micron OM3 or OM4 Multi Mode, encased in orange interlocking armor, terminate with LC connectors.
HORIZONTAL CABLING	Horizontal Data Cabling shall be Category 6/6A UTP Berktek, General Cables, Hitachi or approved equal, minimum factory sweep tested to 550 MHz, plenum rated, blue sheath, terminated in a gray Category 6/6A modular jack insert and snapped into a 2-gang, furniture, floor box or poke-thru faceplate, terminated on Category 6/6A 48-port IDC patch panels with the EIA-568B sequence, Category 6/6A modular non-booted patch cords. Category 6/6A jacks shall be manufactured by Leviton

HORIZONTAL CABLING	**Office Workstation: (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.** **Classroom Instructor Workstation: (2) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.** **High-Density Workstation: up to (6) Category 6 cables terminated on gray jack inserts into a double gang flush faceplate.** **Emergency Wall-Phone Outlet: (2) Category 6 cables terminated on a gray Leviton jack insert into a double gang faceplate.** **Ceiling-mounted Projector Outlet: (2) Category 6 cables terminated on a gray Leviton jack insert into a single gang faceplate.** **Wireless Access Point Outlet: (2) Category 6A cables with 20-foot slack loops at each workstation, terminated on gray jack inserts into a double gang flush faceplate or surface mount box when mounted above the ceiling.** **IP Camera Outlet: (2) Category 6 cable with 20-foot slack loop at each workstation, terminated on a gray jack insert into a double gang flush faceplate or surface mount box when mounted above the ceiling. IP Camera cabling shall be on separate Category 6 patch panels in each MDF/IDF.** **Emergency Stanchion (Blue Light/Phone): (1) Category 6 4-pair voice-grade PE-39 flooded 22 AWG UTP cable from the closest MDF or IDF to each stanchion-mounted blue light phone location. Terminate the cable on a 4-pair lighting protection module at each end.**
GROUNDING	**Grounding shall be designed and installed in accordance with ANSI-J-STD-607-A.** **Install a Telecommunications Main Grounding Busbar (TMGB) (per building) in the MDF and IDF-1s, and a Telecommunications Grounding Busbar (TGB) in each IDF-2.** **Install a Telecommunications Bonding Backbone (TBB), #3/0 AWG stranded green insulated copper conductor in a star topology between the TMGB and each TGB in each building. When IDFs are stacked a single TBB can be daisy-chained between TGBs back to the TMGB.** **Install an Equipment Bonding Conductor (EBC), #6 AWG green insulated conductor from the TMGB or TGB as applicable to each cable runway system, equipment rack, cabinet, lightning protector, or multi-pair cable with a metallic element.** **Install a #3/0 AWG stranded green insulated copper conductor from the TMGB to the main building electrical service ground in each building.** **In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TGB and TMGB shall be bonded to the vertical steel metal frame using a minimum #6 AWG conductor.** **Install a Grounding Equalizer Conductor, #3/0 AWG stranded green insulted copper conductor to interconnect multiple TBBs on the top floor and every 3rd floor when required by ANSI J-STD-607-A.**

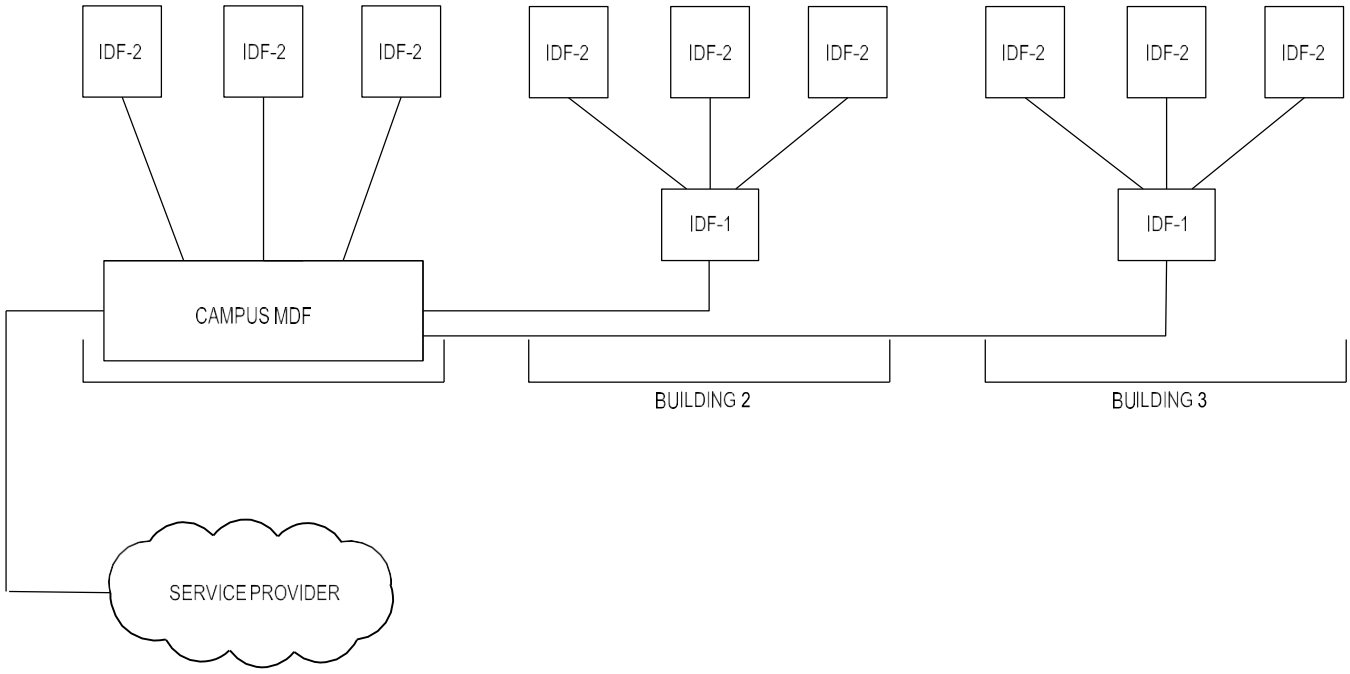
LABELING	**Verify room numbers and confirm the final room numbering scheme prior to generating labels.** **Backbone Fiber and Copper Cables shall be labeled within 12 inches of the visible end of the jacket.** **Fiber Innerduct shall be labeled within 12 inches of the point of entry of the fiber optic enclosure.** **Cables shall be labeled identically at both ends.** **MDFs and IDFs Room shall be labeled (signage) with the permanent room designations that match the final building signage for cable labeling.** **Equipment racks in each MDF or IDF shall be labeled in sequential numeric order. Labels shall be centered on the top front of the equipment rack.** **Fiber optic backbone cable labels shall contain the cable origin room number, the cable destination room number, fiber strand numbers, and type (i.e. MDFA150-IDFC126-50MM001-024/SM001-012).** **Fiber optic enclosures shall be labeled alpha-numeric starting with the 1st fiber optic enclosure in the top of the 1st equipment rack. A label for each terminated strand shall be securely placed inside each fiber optic enclosure.** **Fiber optic couplers panels in fiber enclosures shall be labeled at each end by strand denoting MDF and/or IDF the cable comes from, and Strand number to and from respectively (i.e. IDFC126-50MM001-012).** **Copper backbone cable labels shall contain the cable origin room number, the cable destination room number, and cable pairs (i.e. MDFA150-IDFC126/001-025).** **Patch panels in each closet shall be uniquely alphabetically labeled sequentially starting with the first Patch Panel in the top of the first equipment rack (i.e. A, B, C, D, E, etc.). Each MDF or IDF starts with A and shall not repeat a letter. Any MDF/IDF room with more than 26 patch panels shall start with AA,BB,CC…** **110-type blocks shall contain the origin room number, destination room number, and pair numbers, under each pair termination. (i.e. MDFA150-IDFC126-PR 1-25). 110-type block labels shall be printed on product-specific label strips and placed into label holders.**

LABELING	**Workstation Faceplates shall be labeled denoting origin MDF/IDF Room Number, patch panel, and port number (i.e. IDFC126-B5).** **When a Wireless Access Point or IP Camera workstation is installed above the ceiling grid, a label identical to the label on the surface mount box shall be permanently attached to the ceiling grid directly below the surface mount box.**
TESTING	**Terminated fiber optic strands shall be tested bi-directionally end to end be and certified in accordance with applicable industry standards with a light meter and OTDR field tester(s) that are within their calibration period.** **Terminated backbone copper cable links shall be tested in accordance with applicable industry standards for attenuation, continuity, and pin-mapping with approved field tester(s) that are within their calibration period.** **Terminated Category 6/6A UTP cable shall be tested as a Permanent Link in accordance with applicable industry standards for Category 6/6A compliance with approved field tester(s) that**

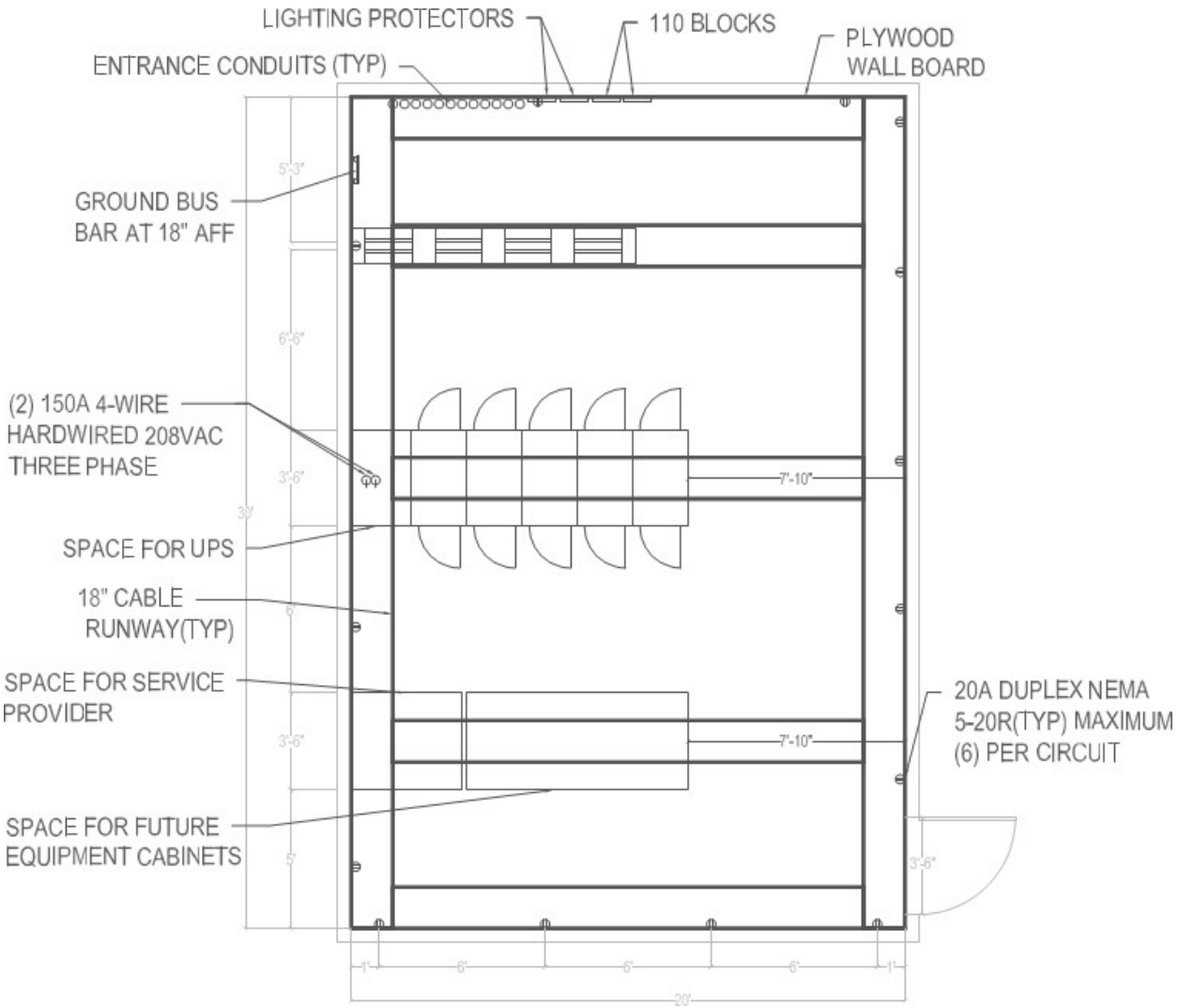
PART 8 - Telecommunications Diagrams



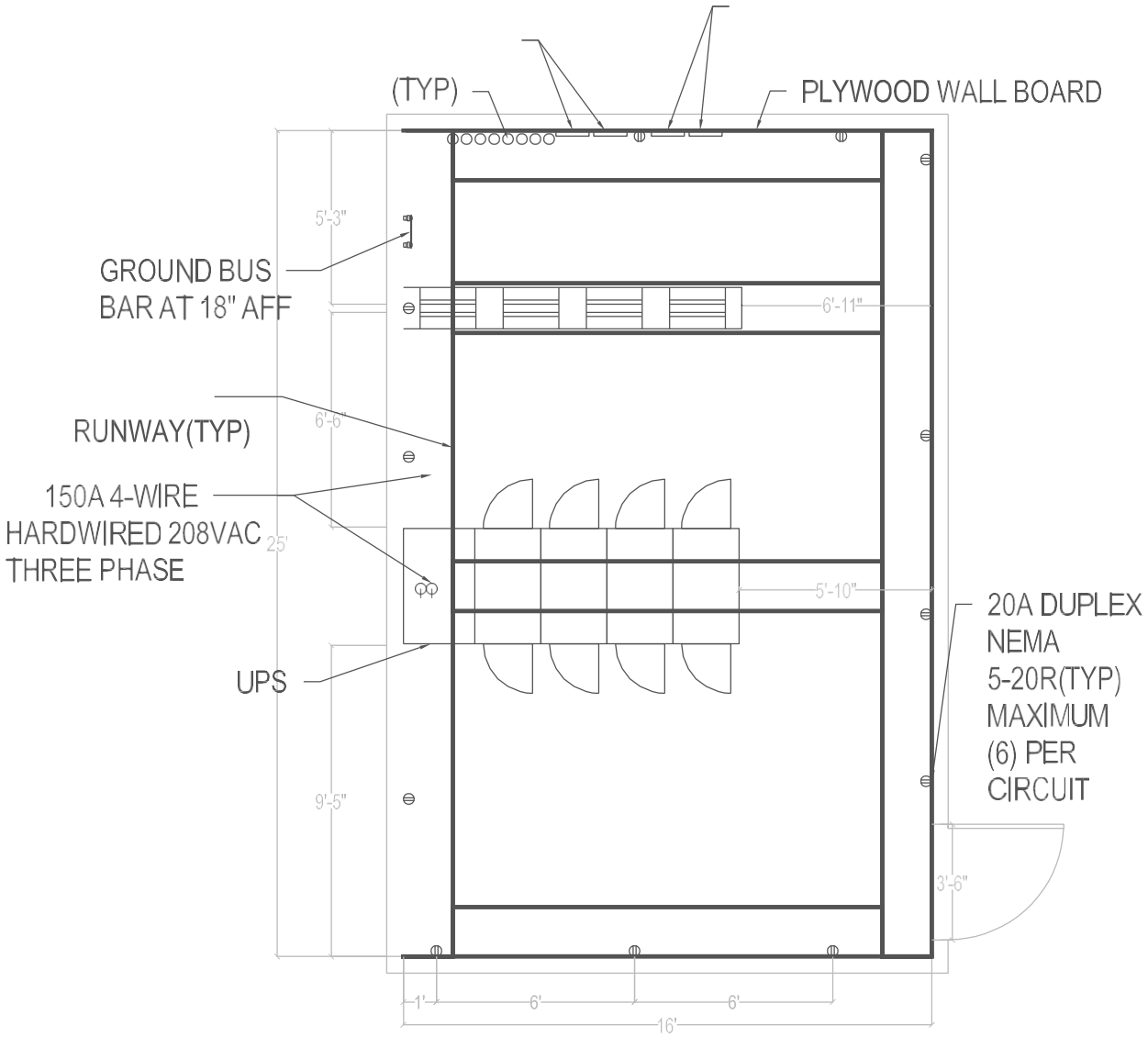
trueNORTH consulting group 3408 Hillcrest Dr Waco, TX 76712 ph.512.451.5445 fax:512.451.8777 www.tncg.com	Project Title: ALAMO COLLEGES TECHNOLOGY STANDARDS AND SPECIFICATIONS	Sheet: 7-500
	Drawing Title: SINGLE STAND ALONE BUILDING TOPOLOGY AND BLOCK DIAGRAM	



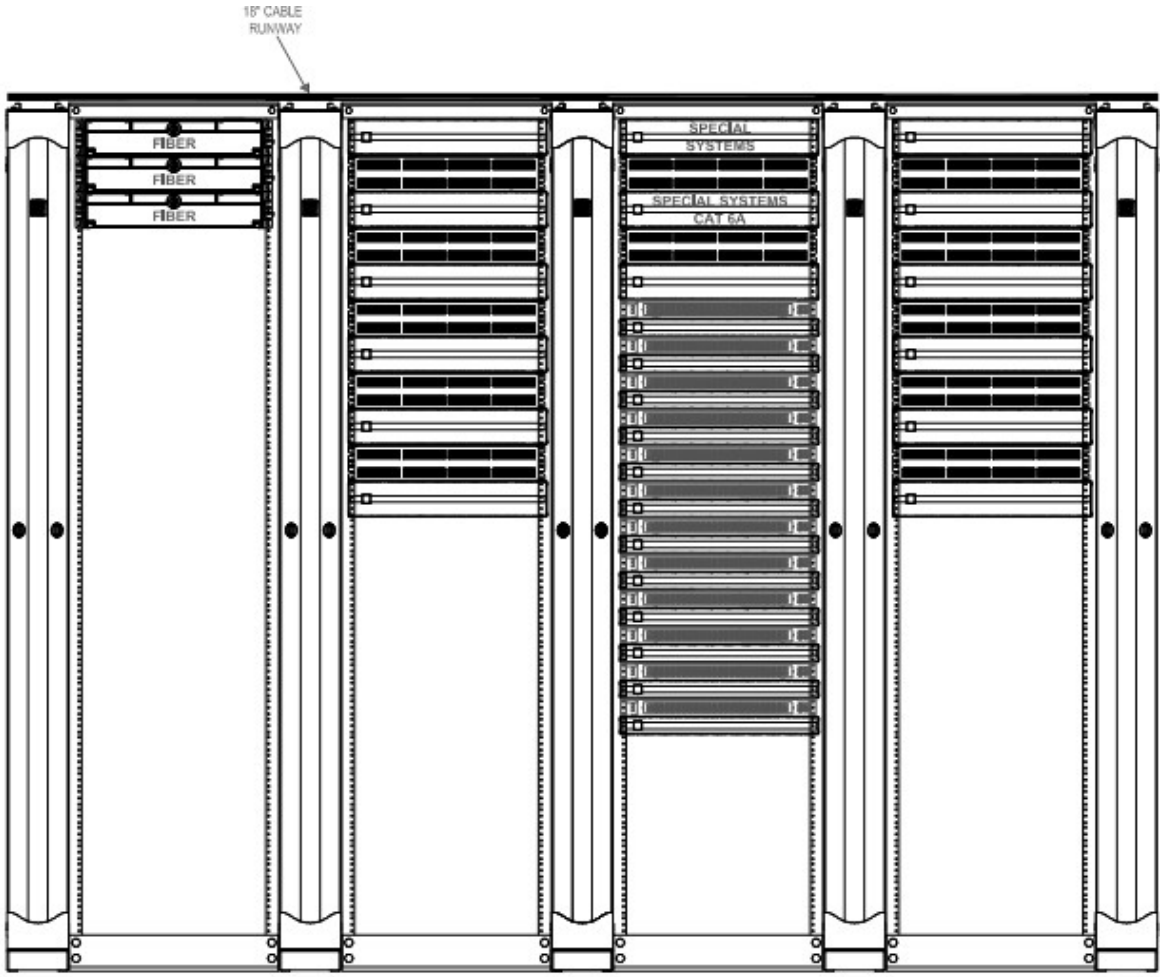
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	Drawing Title COPPER BACKBONE LABELING SCHEME	



trueNORTH consulting group 3408 Hillcrest Dr Waco, TX 76712 ph.512.451.5445 fax: 512.451.8777 www.tncg.com	Project Title: ALAMO COLLEGES TECHNOLOGY STANDARDS AND SPECIFICATIONS	Sheet: T-502
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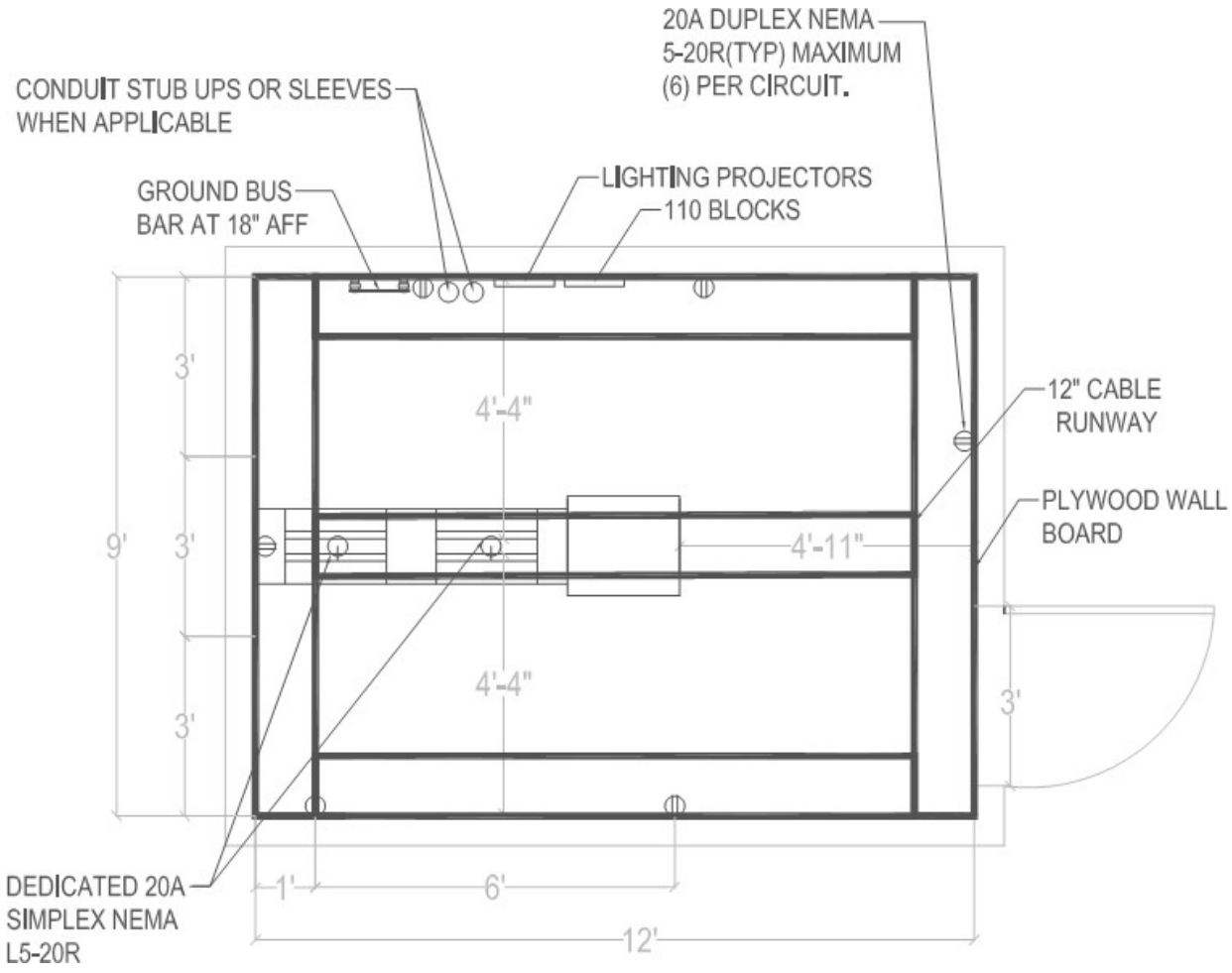


trueNORTH consulting group 3408 Hillcrest Dr Waco, TX 76712 ph.512.451.5445 fax: 512.451.8777 www.tncg.com	Project Title: ALAMO COLLEGES TECHNOLOGY STANDARDS AND SPECIFICATIONS	Sheet: T-503
	Drawing Title: TYPICAL CAMPUS MDF ROOF LAYOUT	

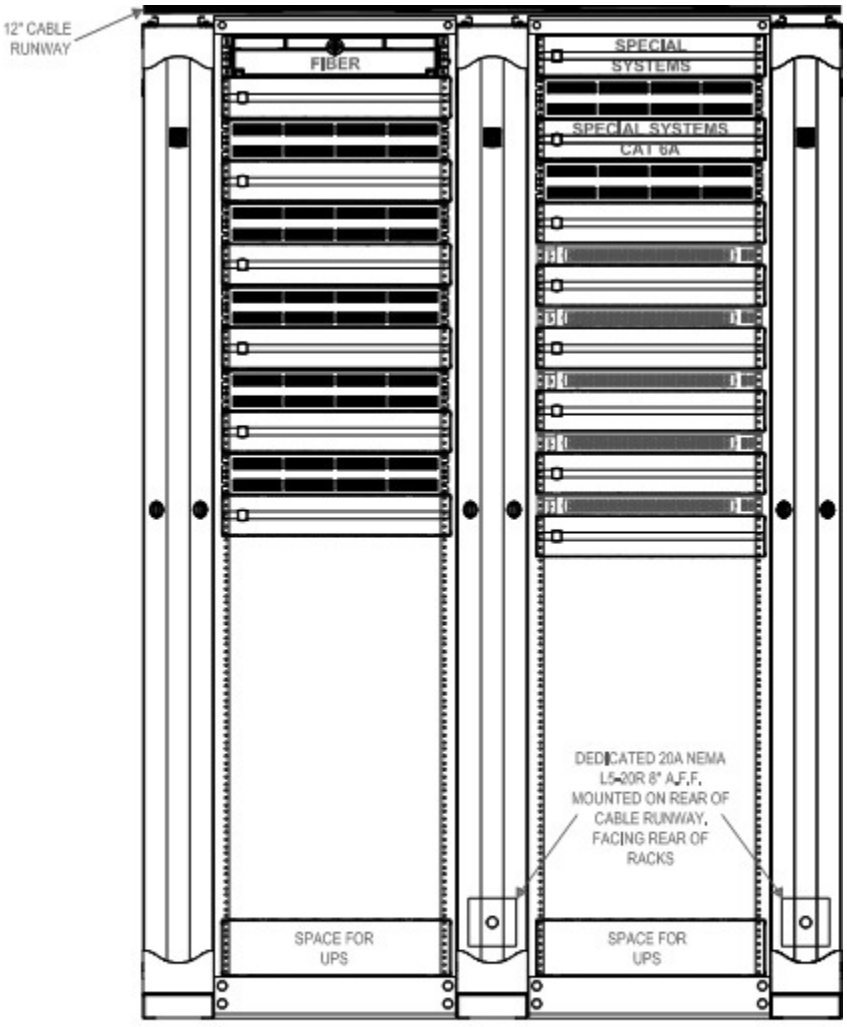


NOTE: 1. SPECIAL SYSTEM SECURITY, BMS, AV, CAMERAS, HVAC, FIRE ALARM, DIGITAL SIGNAGE
2. SPECIAL SYSTEM CAT 6A WAPS,UPLINK

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	Drawing Title: TYPICAL CAMPUS MDF RACK ELEVATION	

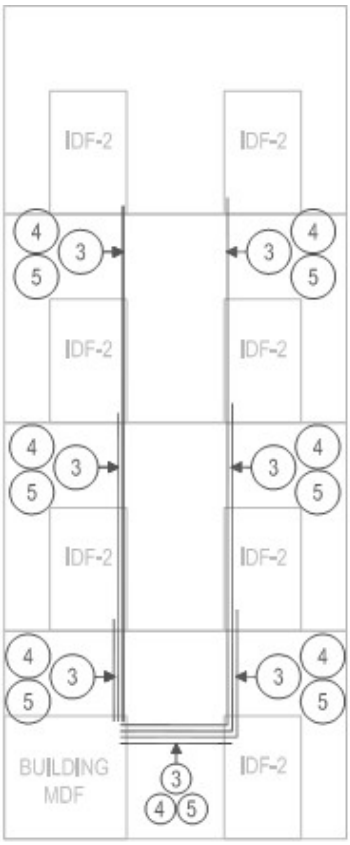


trueNORTH consulting group 3408 Hillcrest Dr Waco, TX 76712 ph.512.451.5445 fax: 512.451.8777 www.tncg.com	Project Title: ALAMO COLLEGES TECHNOLOGY STANDARDS AND SPECIFICATIONS	Sheet: T-505
	Drawing Title: TYPICAL BUILDING IDF ROOM LAYOUT	



NOTE: 1. SPECIAL SYSTEM SECURITY, BMS, AV, CAMERAS, HVAC, FIRE ALARM, DIGITAL SIGNAGE
2. SPECIAL SYSTEM CAT 6A WAPS, UPLINK

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	Drawing Title: TYPICAL IDF ROOM LAYOUT	



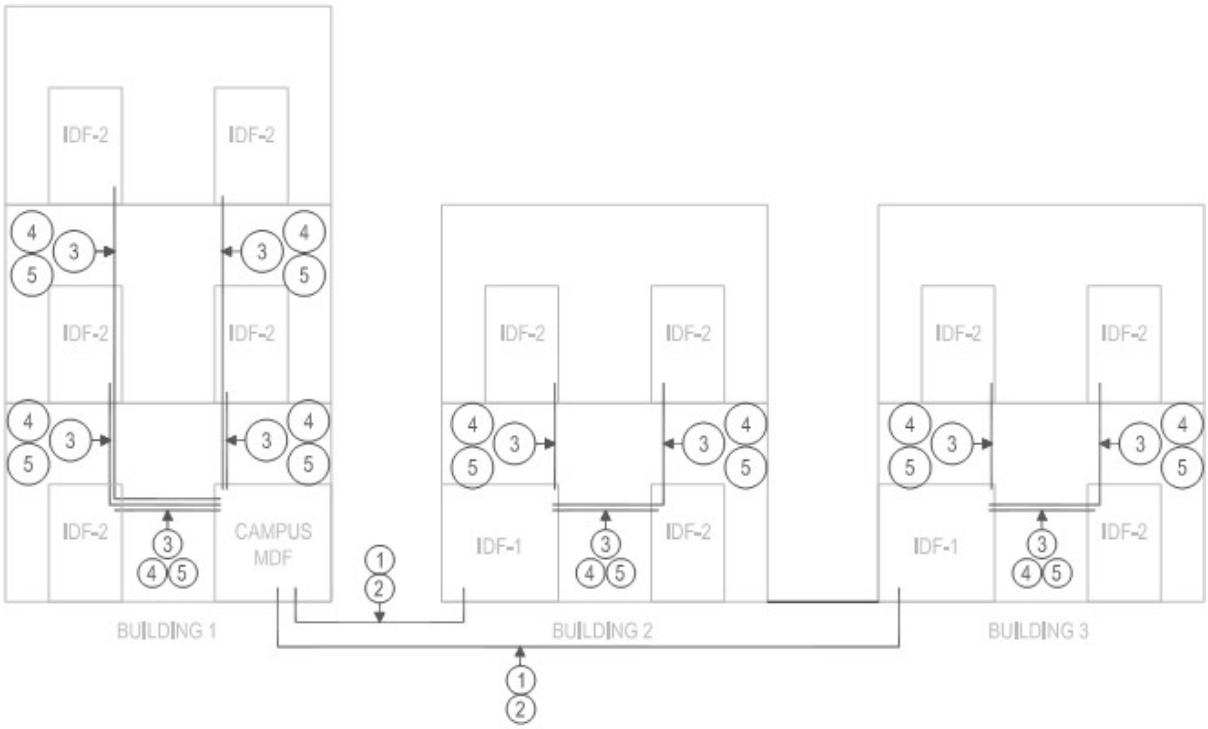
1. 24-STR 50 MICRON OM3 MULTI-MODE/12-STR 9 MICRON SINGLE MODE FIBER
2. 50-PAIR PE-39 OSP COPPER UTP
3. 12-STR 50 MICRON OM3 MULTI-MODE/6-STR 9 MICRON SINGLE MODE ARMORED
4. 25-PAIR CATEGORY 3 UTP
5. (2) CATEGORY 6A UTP, PATCH PANEL TO PATCH PANEL

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Project Title: ALAMO COLLEGES
TECHNOLOGY STANDARDS AND SPECIFICATIONS

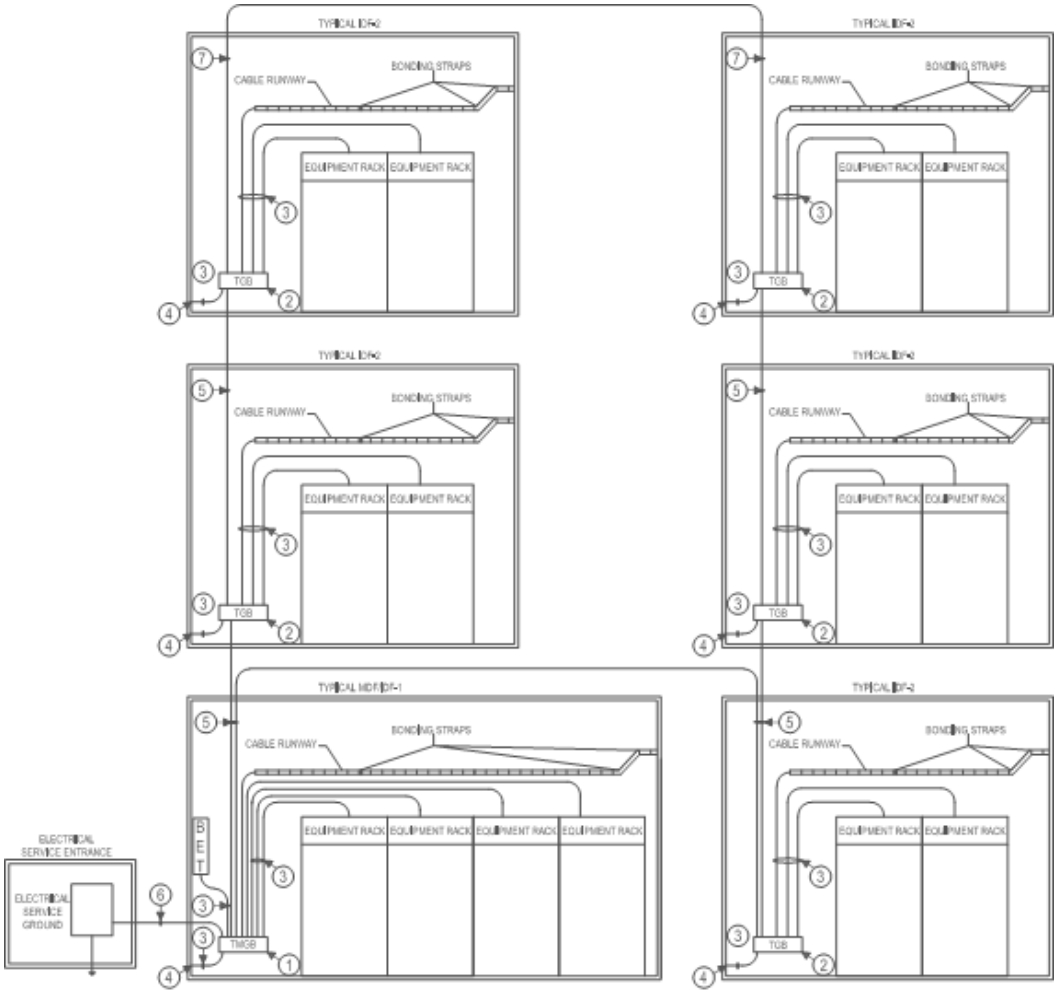
Sheet: T-507

Drawing Title: SINGLE STAND-ALONE BUILDING UPLINK AND RAISER DIAGRAM



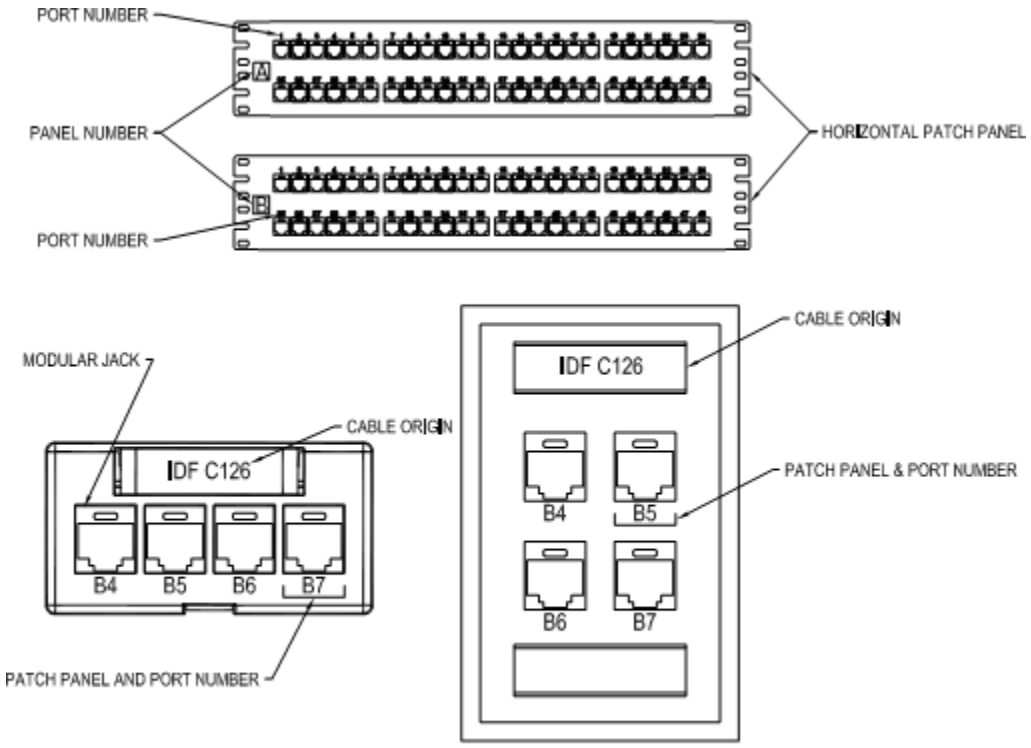
1. 24-STR 50 MICRON OM3 MULTI-MODE/12-STR 9 MICRON SINGLE MODE FIBER
2. 50-PAIR PE-39 OSP COPPER UTP
3. 12-STR 50 MICRON OM3 MULTI-MODE/6-STR 9 MICRON SINGLE MODE ARMORED
4. 25-PAIR CATEGORY 3 UTP
5. (2) CATEGORY 6A UTP, PATCH PANEL TO PATCH PANEL

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	Drawing Title: CAMPUS UPLINK AND RISER DIAGRAM	



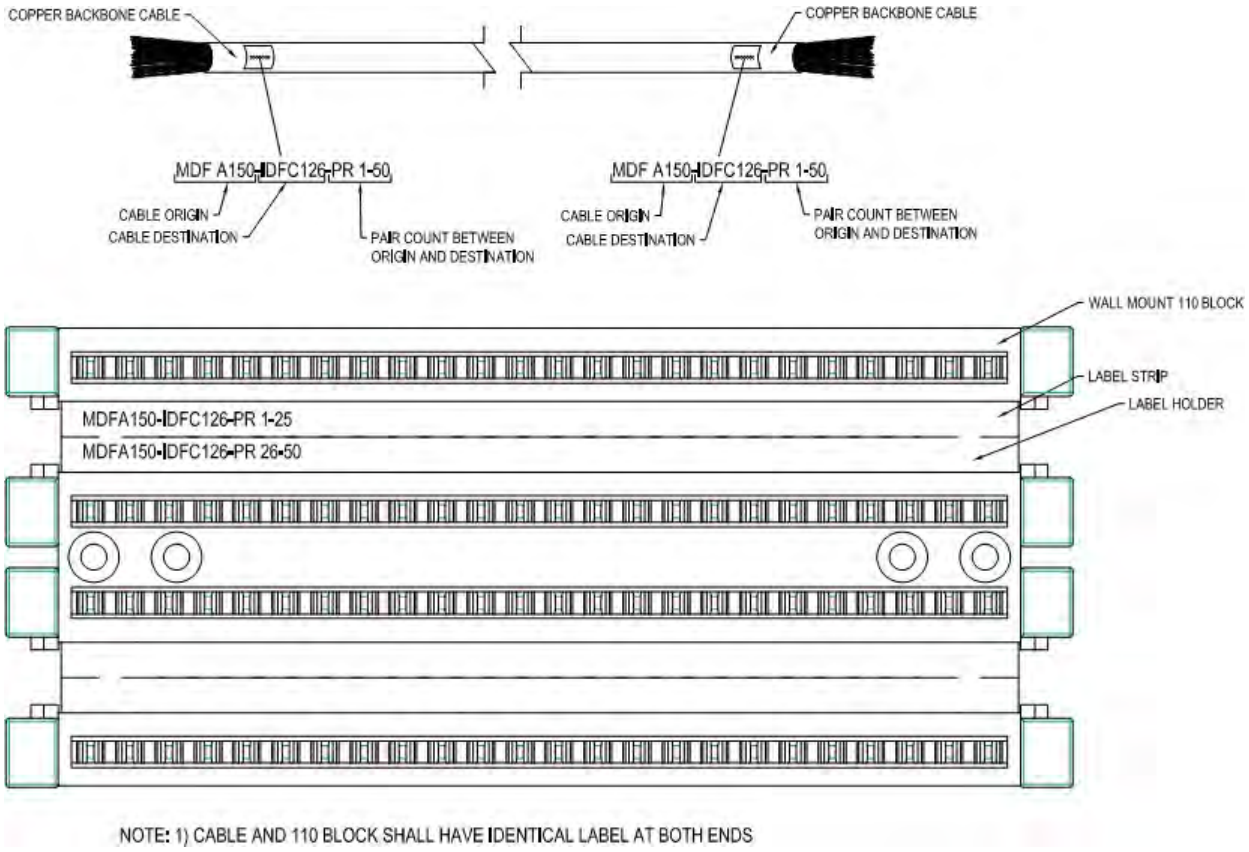
1. TELECOMMUNICATIONS MAIN GROUNDING BUS BAR (TMGB)
2. TELECOMMUNICATIONS GROUNDING BUS BAR (TGB)
3. TELECOMMUNICATIONS BONDING CONDUCTOR (TBC) #6 AWG
4. CONNECT TO GROUNDED BUILDING STEEL WHEN EXPOSED IN ROOM.
5. TELECOMMUNICATIONS BONDING BACKBONE (TBC) #3/0 AWG
6. TELECOMMUNICATIONS BONDING CONDUCTOR (TBC) #3/0 AWG BY ELECTRICAL CONTRACTOR
7. GROUNDING EQUALIZER CONDUCTOR (GEC) #3/0 AWG

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	Drawing Title: TYPICAL GROUNDING DIAGRAM PROVIDED BY CABLING CONTRACTOR U.N.O	



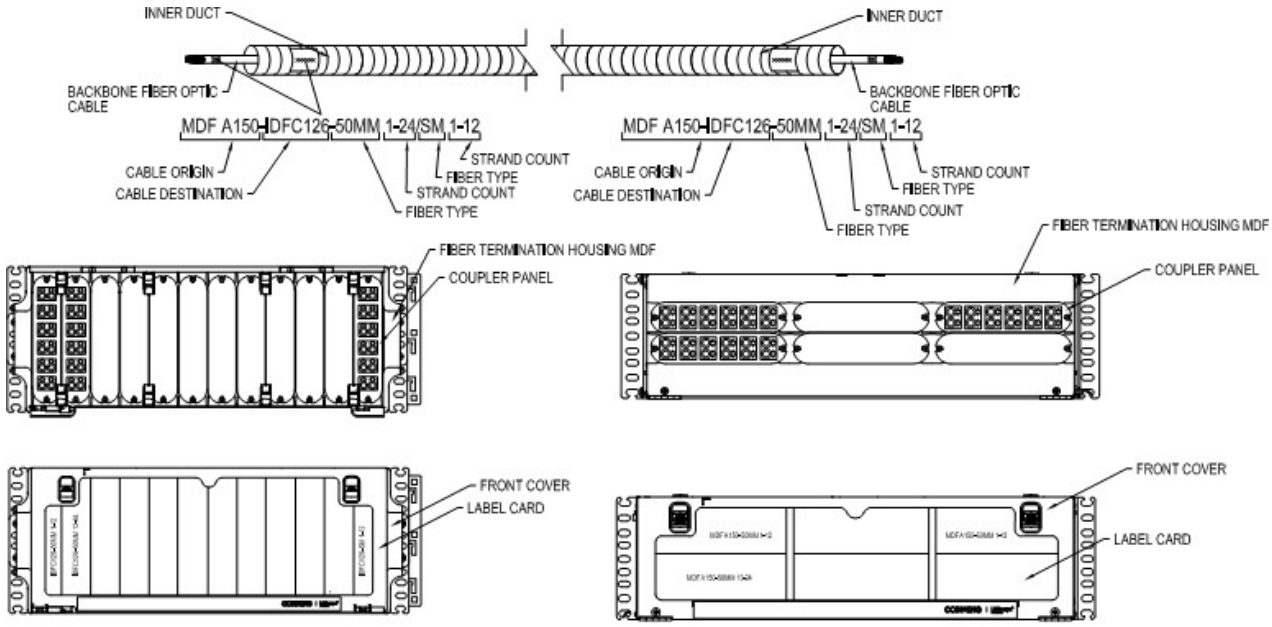
NOTE: 1) CABLE SHALL HAVE IDENTICAL LABEL AT BOTH ENDS
2) EACH PATCH PANEL SHALL BE UNIQUELY LABELED ALPHABETICALLY IN EACH MDF OR IDF

trueNORTH consulting group 3408 Hillcrest Dr Waco, TX 76712 ph.512.451.5445 fax: 512.451.8777 www.tncg.com	Project Title: ALAMO COLLEGES TECHNOLOGY STANDARDS AND SPECIFICATIONS	Sheet: T-510
	Drawing Title: HORIZONTAL DATA CABLE LABELING SCHEME	



NOTE: 1) CABLE AND 110 BLOCK SHALL HAVE IDENTICAL LABEL AT BOTH ENDS

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	Drawing Title: COPPER BACKBONE LABELING SCHEME	



NOTE: 1) CABLE AND INNERDUCT SHALL HAVE IDENTICAL LABEL AT BOTH ENDS

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	Drawing Title: FIBER BACKBONE LABELING SCHEME	

END OF SECTION 27 00 00

Division 27 – Communications

SECTION 27 05 00 – COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - General

1.1 Project Summary

A. Scope: Successful bidder shall provide, install, configure, and provide warranty service for technology systems described herein.

1.2 Related Documents

A. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.

1.3 Related Work

A. Section 27 10 00 – Communications Cabling General Requirements

B. Section 27 10 05 – Grounding and Bonding for Technology Systems

C. Section 27 11 00 – Communications Equipment Rooms

D. Section 27 13 00 – Communications Backbone Cabling

E. Section 27 15 00 – Communications Horizontal Cabling

F. Section 27 16 00 – Communications Connecting Cords

G. Section 27 18 00 – Communications Labeling and Identification

1.4 Owner design session:

A. The Contractor shall pro-actively schedule a pre-installation coordination meeting with the Technology Department to review ground system design prior to completing design documents.

B. Design review meetings shall cover the following systems:
   1. MDF/IDF layout and equipment schedules.
   2. Backbone and up-link requirements.
   3. Horizontal cable pathways, termination hardware, colors and labeling.
   4. Patch cords (qty, colors and lengths)

1.5 Definitions

A. Approved or Approval: Where approval is called for, only persons with the authorized authority may grant approval. Owner reserves all rights to govern over and grant approval and will appoint authority of agents acting on their behalf.

B. As Required: Contractor shall provide the quantity of said item that is necessary. Owner and Consultant reserve the right to make the final determination of necessary quantities to provide for a complete system.

C. Basis of Design: The documentation of the concepts, calculations, decisions, and product selections used to meet the Owner's project requirements. These Consultant produced documents are not shop drawings. Product selections depict minimum functionality and overall quality and are open to substitution requests.

D. Consultant: True North Consulting Group.

E. Contractor: The qualified party responsible to provide all items and perform services as described within these documents. The Contractor referred to within a specific specification section shall be the successful qualified party contracted to perform and complete that work.

F. Documents: The complete package of Bid and Contract Requirements, General Technology Requirements, related Division 27 sections, drawings, schedules, and addenda that make up this Request for Bid.

G. End-User: Individual(s) who will ultimately operate the completed system.

H. ETR: Existing to Remain. Item is to remain in current location and maintain current functionality.

I. Furnish: To supply and deliver to project site, ready for installation.

J. Install: To place in a position of service or use.

K. NIC: Not in Contract. Item will be the responsibility of others.

L. Notice to Proceed: Formal communication from Owner to Contractor stating the date the Contractor can begin work subject to the conditions of the contract. The performance time of the contract starts from the Notice to Proceed date.

M. OFCI: Owner Furnished Contractor Installed. Item will be provided by Owner and shall be installed by Contractor.

N. OFE: Owner Furnished Equipment. Item will be provided and integrated by Owner.

O. OFOI: Owner Furnished Owner Installed. Item will be provided and installed by Owner.

P. Owner: The party named in the Procurement and Contract Requirements as the advertising party.

Q. Provide: To furnish and install, complete and ready for intended use.

R. Turnkey: Of or involving the provision of a complete product or service that is ready for immediate use.

S. Work: The provision of products and/or services to meet the requirements specified in these documents.

1.6 Reference Standards and Codes

A. Standards and other procedures referenced by this bid package are as follows:

1. ADA – Americans with Disabilities Act of 2010 www.ada.gov/2010ADAstandards_index.htm
2. AIA – American Institute of Architects www.aia.org
3. ANSI – American National Standards Institute www.ansi.org
4. ASHE – American Society of Healthcare Engineering www.ashe.org
5. ASTM – American Society of Testing and Materials www.astm.org
6. BICSI – Building Industry Consulting Service International, Inc. (RCDD Standards) www.bicsi.org
7. CFR–Code of Federal Regulations www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR (Available from the Government Printing Office) (Material is usually first published in the Federal Register)
8. U.S. Copyright Law, December 2011 www.copyright.gov/title17
9. ECIA – Electronic Components Industry Association ESC – EIA Standards Council www.eciaonline.org
10. IACS – International Annealed Copper Standard www.ndt-ed.org/GeneralResources/IACS/IACS.htm
11. IEC – International Electrotechnical Commission www.iec.ch
12. IEEE – Institute of Electrical and Electronics Engineers standards.ieee.org
13. ISO – International Organization for Standardization www.iso.org
14. ITU-T – International Telecommunication Union – Telecommunication www.itu.int
15. NEC – National Electrical Code (NFPA 70) maintained by NFPA – National Fire Protection Association www.nfpa.org
16. NECA – National Electrical Contractors Association www.necanet.org
17. NEMA – National Electrical Manufacturers' Association www.nema.org
18. OSHA – Occupational Safety and Health Administration (U.S. Department of Labor, OSHA) www.osha.gov
19. TIA – Telecommunications Industry Association www.tiaonline.org/standards
20. UL – Underwriters' Laboratories www.ul.com

B. Standards: Referenced standards and/or procedures shall be binding on the Contractor and work shall be judged against such standards and procedures unless otherwise stated in writing.

C. Local/State Codes: Contractor shall comply with all local and state code requirements as determined by the authority having jurisdiction (AHJ).

D. Owner Standards: Contractor shall obtain and abide by all published Owner standards as they pertain to the work described herein.

E. Contractor shall use the latest versions of all standards and codes unless otherwise directed by the authority having jurisdiction (AHJ) or expressly noted herein.

1.7 Drawings and Basis of Design

A. General: Work, equipment, or material delineated on any drawing in this package is expected to be provided by Contractor unless noted otherwise.

B. Interpretation: Work shall be installed in accordance with the basis of design diagrammatically expressed on the drawings and described in the written specifications and equipment schedule(s). Contractor shall not make limiting interpretation that provides for incomplete work or a non-functioning system.

1.8 Product Substitution Procedures

A. Requests for Substitutions: Should the Contractor request a change in the material that is to be supplied, from that which was specified in the contract, the Contractor shall provide the Owner and the Consultant with a written request for said change.

B. Substitutions for Non-specified Products: Where no product specification is provided, Contractor may use manufacturer's specification for the identified product as a guide for suggesting appropriate substitutions.

C. Requirements: The Request for Substitution shall include:
   1. Reason for substitution.
   2. Material data sheets for both the proposed item(s) and the item(s) to be replaced.
   3. Any cost impact to the Owner.

D. Changes: Proposed changes to Contract Documents shall be clearly identified in the pre-construction submittals.

E. Approval: The Owner may approve or deny any Requests for Substitution. The Owner reserves the right to govern over and proclaim whether proposed products are equal to the specifications. The Contractor shall not procure any substitute materials until the Owner has approved and signed the Request for Substitution and passed copies to the Contractor and the Consultant. Any procurement or work performed prior to this approval is at the Contractor's own risk.

F. Deviation: Products provided or installed that deviate from the products specified in make, model, color, or other significant characteristic (i.e., non-approved substitutions) shall be removed and replaced with specified products at no additional expense to Owner.

1.9 Software

A. Versions: Consultant used the following software versions for this project:
   1. Microsoft Office 2016
   2. Autodesk Revit MEP 2014 (floor plans)
   3. Autodesk AutoCAD MEP 2014 (detail sheets)

1.10 Submittal Conditions

A. The Contractor shall not consider the Consultant or Owner's review of submittals to be exhaustive or complete in every detail. Approval of shop drawings or submittals including substitutions indicates only the acceptance of the Contractor's apparent intent to comply with general design or method of construction and quality as specified. The finished product shall meet functional requirements, operations, arrangements, and quantities and comply with the contract documents unless specifically approved otherwise.

B. The Contractor shall be held responsible for delivery of systems as specified. Any errors or omissions in the submittals shall not relieve Contractor of responsibility to deliver complete systems as specified.

1.11 Pre-Construction Procedures

A. Pre-Construction Submittal Meeting: Contractor shall schedule web conference (WebEx or similar) with Owner and Consultant to review basis of design and submittal expectations.

B. Prior to Work: Pre-construction submittals shall be provided to Consultant with appropriate promptness as to cause no delay to the work.

C. Project Timeline: Project timeline will not be altered due to lateness of submittals. Contractor is bound to deliver a timely, complete, and finished project as stipulated in their contract and specified herein.

D. Format and Distribution: Contractor shall provide one (1) electronic copy in PDF format to Consultant of all pre-construction submittals. The Contractor shall provide hard copies sets as required up to five (5) sets.

E. Provision: Contractor shall submit pre-construction submittals including any corrections or additions to Consultant prior to the procurement of equipment or commencement of work.

F. Review: Pre-construction submittals shall be received and formally approved by Consultant prior to the procurement of material or the commencement of work. Any procurement or work performed prior to this approval is at Contractor's own risk.

G. Failure to Provide: The failure of Contractor to provide pre-construction submittals as required herein may result in the withholding of payment for work and/or the cancellation of the contract.

1.12 Pre-Construction Submittals

A. Pre-construction submittals are intended to document the details of installation. Exact copies of original drawings and specifications are not acceptable as pre- construction submittal drawings. Consultant schematic diagrams describe the basis of design as defined herein.

B. Contractor shall provide to Consultant the following pre-construction submittals for approval in addition to specific requirements identified in subsequent sections.
   1. Qualifications: Shall include documentation of all required qualifications.
   2. Shop Drawings:
      a. Title: Each drawing shall have a descriptive title and all subparts of each drawing shall have unique identifiers.
      b. Floor Plans: Shall include device locations, Contractor provided furniture and installation notes.
      c. System Drawings: Shall include functional diagrams for each system detailing system flow including all equipment, routing, inputs/outputs, wiring signal type, cable identification detail, connectors, adapters, intra/inter-rack power distribution, installation notes and any other information required to convey the complete turnkey system design.
      d. Equipment Rack and Cabinet Elevations: Shall include placement of all mounted equipment.
      e. Structurally Mounted Elements: Shall include both plan view of placement as well as a detail of structural mounting techniques to be used.
      f. Furniture: Shall include all Contractor provided furniture showing dimensional drawings, cable management and finishes with samples for Owner approval.
   3. Product Data:
      a. Equipment Schedules: Shall include manufacturers, part numbers, quantities and unit pricing.
      b. Product Cut Sheets: Shall identify (highlight, arrow, etc.) actual part numbers to be utilized including but not limited to equipment, mounting hardware, cabling, connectors, software and power distribution equipment.
   4. Manufacturer's Recommendations:
      a. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, copies of these recommendations shall be provided prior to installation. Installation of the items will not be allowed to proceed until the recommendations are received and approved.

1.13 Construction Progress Procedures

A. Meeting Attendance: Contractor is required to attend job progress meetings in accordance with requirements set by Owner or Consultant.

B. Additional Coordination: Contractor shall request additional job construction coordination meetings it deems to be necessary to ensure coordination of their responsibilities with other parties.

C. Progress Inspection: Consultant may perform periodic progress inspections. At Consultant's request, Contractor shall make Project Manager and/or Lead Technician available.

D. Test Plan: Ten (10) business days prior to the proposed Contractor test date, Contractor shall provide a test plan defining the tests required.
   1. The test plan shall be approved by Consultant prior to any testing.

1.14 Construction Progress Submittals

A. Completion: Contractor shall complete and submit via email all construction progress documentation in PDF format as requested by Owner and Consultant.

B. Contractor shall provide to Consultant the following construction progress submittals in addition to specific requirements identified in subsequent sections.
   1. Weekly Report: Weekly written report to be submitted to Consultant through appropriate project channels in PDF format outlining progress from previous week, plans for progress in the current week, and any coordination issues that may require Consultant or Owner attention.
   2. Test Plan: Shall ensure the system meets Owner operational and performance specifications and include the following:
      a. Identification of the capabilities and functions to be tested.
      b. Detailed instructions for the setup and execution of each test.
      c. Procedures for evaluation and documentation of the results.

C. Failure to Complete: Failure to complete requested construction progress documentation may result in the withholding of payment by Owner.

1.15 Closeout Procedures

A. Notification: Contractor shall provide written notification to Consultant and Owner when Contractor is satisfied that the work has reached Substantial Completion and is ready for inspection.

B. Pre-Inspection Submittals: Contractor shall submit an electronic copy of all closeout submittals to Consultant in accordance with the requirements found in these documents no less than ten (10) business days prior to the scheduled Final Inspection.
   1. Test Results
   2. As-built drawings (full-size sheets)
   3. Operation and Maintenance Manuals
   4. End User Software

C. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in these documents, and/or unacceptable to Consultant or Owner shall be documented by Consultant and provided to Contractor to rectify at no additional cost. Contractor shall provide written notification to Consultant and Owner when all punch list items have been completed.

D. Final Inspection: Contractor shall coordinate, schedule and participate in final project inspection and walk thru. Owner shall be notified and included in final walk thru inspections.

E. Re-Inspection: If more than one (1) re-inspection is necessary, the costs of the additional travel, time, and expenses of Owner and Consultant may be deducted by Owner from the contract amount due to the Contractor.

F. Punch List Approval: Once all punch list items are complete, the Contractor shall return an initialed punch list to the Consultant and Owner for verification. Punch list shall be considered complete only after having been signed by Owner and Consultant.

G. Closeout Submittals: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide three (3) electronic copies to Owner and Consultant in format(s) noted below.
   1. Record Drawings – AutoCAD 2010 editable .dwg format AND PDF.
   2. Operation and Maintenance Manuals – USB Flash Drive, CD, OR DVD.
   3. End User Software – USB Flash Drive, CD, OR DVD.
   4. Documentation of testing and system certification.

H. Closeout Submittal Format and Distribution: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide a total of three (3) bound hard copies with labeled dividers of all record drawings (full-size sheets) and operation and maintenance manuals, two (2) copies to Owner and one (1) copy to Consultant. Title on front and spine of binder shall be "Operation and Maintenance Manual – [PROJECT NAME]". The following additional items shall be identified on the binder cover:
   1. Client Name
   2. Contractor Name and Contact Information
   3. Consultant Name and Contact Information
   4. Date

I. All documentation prepared by the Contractor, including hard copy and electronic forms, shall become the property of the Owner.

J. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by Owner and Consultant, including punch list(s) and/or re- inspection(s) and delivery of closeout deliverables.

1.16 Closeout Submittals

A. Closeout submittals are intended to document the details of the final installation that substantially conforms to the construction documents and functions as intended to meet the Owner's needs.

B. Contractor shall provide to Consultant the following closeout submittals for approval in addition to specific requirements identified in subsequent sections.

1. As-built drawings: As-built drawings are prepared by the Contractor. They show, in red ink, on-site changes to the Consultant-approved pre-construction submittal documents. As-built drawings shall be submitted to Consultant for approval prior to submitting record drawings and include:
   a. Changes made by Addenda, Change Orders, Requests for Information (RFIs), Architect's Supplemental Instruction (ASIs), or Requests for Proposal (RFPs) in addition to any other changes to the original documents.
   b. Actual device locations, conduit routing, wiring and relationships as they were constructed.
   c. Nomenclature showing as-built wire designations and colors.
   d. Room numbers coinciding with Owner space planning numbering.
2. Record drawings: Record drawings are the final drawings prepared by the Contractor and incorporate all as-built drawing changes previously approved by Consultant. Record drawings should be electronically produced without any handwritten, red ink, or clouded changes.
3. Operation and Maintenance Manuals: Notwithstanding requirements specified elsewhere, submit one (1) copy of each of the following per binder:
4. A final Bill of Materials for each system.
5. Usernames and passwords by device for all applicable products.
6. Manufacturers Instruction Manuals: Specification sheets, operation manuals and service sheets published by the manufacturers of the components, devices and equipment provided.
7. Replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.
8. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
9. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturers' Warranty Registration papers as described herein.
10. Sufficient information, (detailed schematics of subsystems, assemblies and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.
11. Any other items defined herein.

1.17 Project Management

A. Project Manager: Contractor shall appoint a Project Manager who will be the main point of contact for Owner and Consultant regarding the project.

B. Responsibility: Project Manager is responsible for the following:

1. Successfully completing the contract in a timely manner.

2. Overseeing work and performance of all employees and Subcontractors who have been hired by Contractor and ensuring compliance with specification.
3. Completing and submitting required documentation.
4. Attending project coordination meetings as required by Owner, Consultant, and Contractor. Contractor is responsible for taking minutes of these meetings and distributing copies to all participants.
5. Coordinating with Owner, Consultant, Architect, General Contractor, and other Contractors involved in the project to ensure smooth flow of work and on-time project completion.
6. Providing a written weekly progress update to the Owner and Consultant in a PDF format emailed to the project team.
7. Reporting all unexpected conditions and problems that may result in delay or expense to Owner and Consultant immediately upon discovery.

C. Change of Project Manager: If Contractor seeks to change Project Manager during the course of the Project, such change is subject to prior written approval from Owner.

D. The Owner reserves the right to request a change of project manager at any time for any reason.

1.18 Examination of Existing Conditions

A. Examination: Contractor shall examine the facility and construction documents to the extent necessary to plan for efficient installation strategies prior to the delivery of materials to the site or the commencement of work. Other documents (Architectural Drawings, hardware schedules…) may be made available upon request. Failure to adequately complete the examination shall not result in change order requests.

B. Acceptance of Conditions: Commencement of work by Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to Owner prior to commencement.

C. Observation: If Contractor observes—during preliminary examinations or subsequent work—existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, Contractor shall report these to Owner in a timely manner.

D. Pre-Existing Damage: If Contractor observes damage to finished surfaces before they begin installation in any area, Contractor shall document by taking digital photos of the damaged area(s) and immediately notifying Construction Manager and Consultant via email, with attached photos.

E. Damage during Installation: Any damage caused by, or reasonably believed by the Construction Manager to be caused by the Contractor shall result in back-charges for said damages. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

1.19 Product Storage and Handling Requirements

A. Storage: Storage of materials shall remain the full responsibility of Contractor until Acceptance.

B. Protection: Contractor shall take all necessary precautions to protect materials from the following:
   1. Theft
   2. Vandalism/Tampering
   3. Dents
   4. Scratches
   5. Dust
   6. Temperature
   7. Weather
   8. Cutting
   9. Paint
   10. Other hazardous conditions

C. Replacement: Contractor shall replace any damaged or lost material as required by Owner or Consultant.

D. Istalled Materials: Installed materials remain the responsibility of the Contractor until Acceptance. Contractor shall take necessary precautions to ensure the safety and security of installed materials.

1.20 On-Site Conduct

A. Tobacco Free: Alamo Colleges are 100% smoke free campuses and also prohibit e- cigarette use, hookah use, and prohibit smoking/vaping.

B. Conduct: Any demonstration of rudeness, use of profanity, or lack of respect by Contractor Personnel to a building tenant will be cause for immediate removal from the premises, and such Personnel will not be allowed to return. Contractor and Contractor's Personnel are to remain in project area.

C. Vandalism: Graffiti or vandalism will not be tolerated. Any Contractor/Personnel caught in the act shall be immediately removed from the premises and will not be allowed to return.

D. Hazardous Conditions: No one shall be allowed to endanger the building, its premises, and its occupants in any manner whatsoever. In the event that a situation occurs which threatens the building or its occupants in any manner, Contractor, Contractor Personnel, Subcontractor, etc. shall take steps to correct hazardous condition. In the event that Contractor's Personnel fail to correct hazardous condition, Owner reserves the right to immediately take steps to correct the situation at Contractor's expense.

1.21 Safeguards and Protection

A. Barriers: Provide and maintain suitable barriers, guards, fences and signs where necessary to accommodate the safety of others relative to and/or for the protection of this work.

B. Regulations: Comply with OSHA, Federal, State, Local, and Owner regulations and standards pursuant to this work.

C. Protection: Protect all materials and equipment to prevent the entry or adhesion of any and all foreign material. If necessary, cover equipment with temporary protective material suitable for this purpose.

D. Finishing: Check, clean and remove defects, scratches, fingerprints and smudges if necessary from all equipment and devices immediately prior to Acceptance of the Installation.

E. Damage: Replace all damaged or defective material or work at no additional cost prior to Final Acceptance.

F. Documentation: Provide written description of accidents by workers, staff, and general public of any incident occurring on the project. Report incident in writing to Owner's representative immediately and to the Project Manager for follow up.

1.22 Owner-Furnished Products

A. Delivery: Owner is responsible for delivery of Owner-furnished products to the project site, unless otherwise specified in this document.

B. Placement: Contractor is responsible for locating, inspecting, and moving Owner- furnished products to their final installation position.

C. Inspection: Contractor shall report any damage, discrepancies in quantity, type, or function to Owner and Consultant immediately upon discovery.

D. Warranty: Contractor assumes no responsibility for any material warranty for Owner-furnished products. Contractor shall be responsible for integrating, cabling, and installing Owner-furnished products under the same warranty conditions as other products furnished by Contractor.

1.23 Quality Assurance

A. Assurance: It is the intent of these specifications to describe and provide for a complete, professional, and reliable installation.

B. Qualifications: Contractor employees who are engaged in installation shall be properly trained in the tasks they are expected to perform.

C. Acceptability: Owner shall determine the acceptability of work.

D. Regulatory Requirements: Contractor shall comply with code requirements that apply to the work being performed.

E. Certifications: Where manufacturer certifications are required for warranty or for authorized resale, installation personnel shall have received such certification prior to the start of installation of those manufacturers' materials.

1.24 Quality Control

A. Installation: During installation period, when connections are made to the Owner's existing infrastructure, Contractor shall use care to ensure that no negative results occur that could reduce or hamper existing systems.

1.25 Owner's Right to Use Equipment

A. The Owner reserves the right to use equipment, material and services provided as part of this work prior to Acceptance of the Work, without incurring additional charges and without commencement of the Warranty period.

PART 2 - Products

2.1 Basic Equipment and Materials Requirements

A. Standards: Equipment and materials used to accomplish the goals of this project shall meet standards for good engineering practice as defined within this document.

B. Quality: Products specified in these documents are intended to establish a baseline or operational, functional, and performance-based standards that all proposed products shall meet or exceed by functionality and quality.

2.2 Ancillary Hardware

A. General: Contractor shall provide ancillary and required accessory items necessary to provide a complete and fully functional system to Owner.

B. Interpretation: Exclusion of or limitation in the language used in the drawings or specifications shall not be interpreted as meaning that ancillary or accessory items of work or equipment necessary to complete or make the installed system fully functional can be omitted.

2.3 Grounding Hardware

A. Refer to Section 27 10 05 for specific Grounding and Bonding requirements.

B. Provide data/telecommunication grounding systems indicated in the project drawings and specifications. Products shall include, but are not limited to, cables/wires, connectors, terminals, compression lugs, grounding rods/electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, ANSI/TIA and established industry standards for applications indicated.

2.4 Fire Stopping Materials

A. All penetrations of walls shall be approved by the General Contractor before any penetrations are made. Should the Contractor find it necessary to penetrate any walls extending to the slab, it will be the responsibility of that Contractor to provide satisfactory sleeving and fire caulking both inside and outside of that sleeving. If existing sleeving is to be utilized, it will be the responsibility of the Contractor to fire caulk inside the sleeving.

B. The Contractor is responsible for adhering to the following standards:

1. Fire-Rated Cable Pathways: STI EZ-PATH® Fire-Rated Pathway device modules comprised of steel pathway with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill shall be used for all wall penetrations at an IDF or MDF room or any penetrations with greater than 20 horizontal cables
2. Small Conduit penetrations through fire-rated or smoke walls (less than 20 horizontal cables: Completely seal around the conduit penetration with Hilti fire-rated sealant Tremco, EZ PATH, 3M or approved equal.
3. Completely seal inner opening of the conduit sleeve with fire wool packing and Hilti intumescent firestop sealant.

C. A submitted response to this specification assumes that all firestopping will be provided as specified. The firestop manufacturer's specifications and instructions shall be submitted with the final documentation.

D. Firestop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:

2.5 Compatibility of Related Equipment

A. Existing Equipment: Equipment and systems specified in these documents shall be assumed to be compatible with the systems already installed at Owner site(s) and as identified in this document as related to this project.

B. Installed Equipment: Specified equipment and systems shall be compatible with all other equipment and systems as offered by Contractor, thus placing the responsibility on Contractor to ensure proper interaction.

2.6 Spare Parts

A. Suggested List: Contractor is requested to submit a list of suggested spare parts with an offered price, allowing Owner to select appropriate parts.

B. Means of Obtainment: Contractor shall state where spare parts can be obtained after the installation.

2.7 Maintenance Manuals

A. Contractor shall produce a maintenance manual showing interconnection of equipment and any special procedures necessary for proper operation and maintenance of the systems.

PART 3 - Execution

3.1 General

A. Contractor shall provide, furnish, deliver, transport, erect, install, connect and configure all of the material and equipment described herein or depicted on any bid package document or drawing, as required for a turnkey solution.

3.2 Coordination

A. General: Contractor shall cooperate with other Contractors for proper provisioning, anchorage, placement, and execution of all work. Interference between the work of various Contractors shall be resolved before installation. In the event of conflict on space requirements or location of devices, refer the matter to Owner and Consultant for decision.

B. Related Work: References to the following related work do not limit or release Contractor from the responsibility of coordination with other trades or from having the necessary knowledge of other non-referenced work.
   1. Work by General Contractor.
   2. Work by other Technology Contractors.
   3. Work by Electrical Contractor, including electrical rough-ins and surface- mounted raceway.

C. Delays: Contractor shall coordinate with all other trades to avoid causing delays in the installation schedule.

D. AC Power: Contractor shall coordinate with General Contractor its requirements for proper AC power to service all equipment installed by Contractor.

E. Low Voltage Sleeving: Contractor shall provide openings through walls as necessary, with sleeving and fire-stopping materials installed in a professional manner to meet local and national codes.

F. Grounding and Bonding: Contractor shall coordinate with General Contractor its requirements for proper grounding and bonding to their equipment.

G. Surface-Mounted Raceway Coordination
   1. General and Electrical Contractors: Contractor shall coordinate with General Contractor and Electrical Contractor the installation of surface-mounted- raceway where not provided but made necessary by non-penetrable wall.
   2. Verification: Contractor shall field verify and coordinate the proposed use of surface-mounted raceway at any location with Architect, GC, and Owner.

3.3 Basic Execution Requirements

A. General: Contractor is responsible for following industry standards of good practice for telecommunications and networking equipment.

B. Aesthetic Factors: With the installation of equipment and cables, consideration shall be given not only to operation efficiency but also to overall aesthetic factors. Contractor shall redo, at no cost to Owner, any work deemed by Owner to appear sloppy, hastily done, or unprofessional. Owner shall make final decision over whether work shall be redone.

C. Manufacturers' Recommendations: Manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless otherwise noted herein.

D. Protection of Work Area: Work shall be properly protected during construction, including the shielding of soft or fragile materials, protecting against dust and dirt, protecting and supporting cable ends off of the floor and from other traffic, protecting floor box lids, and temporarily plugging open conduits during construction. Upon completion, installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of work shall be removed from the premises.

E. Protection of Cable and Equipment: Contractor shall make appropriate preparations to protect all cabling and equipment from foreign material. Foreign material is defined as any substance or material that would void the manufacturer's performance warranty, impact ratings (UL, Plenum, etc.), or cover up markings needed for inspection. Foreign material includes, but is not limited to, paint overspray (intentional or not), fire-stopping material, drywall compound, or any other chemical, liquid, or compound that could come in contact with cables, cable jackets, cable termination points, or other equipment.
   1. Cleaning of cables or equipment with harsh chemicals from a failure to comply with Protection of Cable and Equipment clause is unacceptable. Contractor shall replace any affected cable, cable components, or equipment in their entirety at no additional cost to the project.

F. Waste Materials: Contractor shall keep work area neat, orderly, and free from accumulation of waste materials. Remove trash and debris from the building and job site as required to maintain a clean work

environment at all times. Rubbish shall be moved to a common trash point or receptacle on the job site as determined and directed by General Contractor or Owner.

G. Dumpsters: No construction debris shall be placed in building's dumpsters. Contractor shall provide a dumpster for construction waste and debris at own expense. Said dumpster shall be emptied on a regular schedule. Location of dumpster shall be arranged through Building Management.

H. Ceiling Grid: Contractor shall not hang cable supports from ceiling grid wire.

I. Roof Deck: Contractor shall not shoot into the roof deck for mounting cable hangers.

J. Mounting: Equipment and enclosures shall be mounted plumb and square in relation to the structure.

K. Raised Floor: All cabling installed below the raised floor shall be placed in the provided cable trays with appropriate means to hold cable in place. If no cable tray exists, Contractor shall provide J-hooks to hold cables in place. Sleeves shall be utilized for cable egress.

3.4 Preparation

A. Existing Equipment: Prior to any installation, the Contractor shall prepare the site by removing any remaining debris, leveling equipment racks (where appropriate), and verifying information and systems stated to be in-place are ready for use.

B. Equipment for Installation: Prior to installation, Contractor shall ensure that required major equipment has been secured and is ready for installation.

3.5 Cleaning

A. Daily: At the end of each work period or day, Contractor shall remove excess packing, drilling remnants, and other non-equipment related parts, materials, or debris to ensure a clean, safe, and professional working environment.

B. Carpet: Contractor shall ensure that no damage to carpeting occurs as a result of their work. Contractor shall cover carpets in areas of work to prevent wire debris from entering the carpet.

3.6 Fire Stopping

A. Contractor is responsible for applying fire-stopping material in and around all openings that it creates or are created for it, whether or not specifically indicated in specifications or project drawings, where code requires the use of fire stopping material.

B. Contractor shall ensure that all fire-stopping materials meet appropriate codes and are installed in a neat and workman like manner.

C. If Contractor removes anything from an opening in a fire-rated wall, Contractor shall restore the fire-rating condition of the wall to the same condition as before Contractor started its work. Depending on the size of the opening, this may involve sheetrock patching, in addition to use of other appropriate fire-stopping materials.

D. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction. Provide letter from manufacturer certifying compliance with this section.

E. Cable pathway shall replace conduit sleeves in walls and floors, and;

F. When installed individually in floors, devices shall pass through core-drilled opening utilizing tested floor plates.

G. When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.

H. When installed individually in walls, devices shall pass through core drilled opening utilizing tested wall plates or integrated flanges.

I. When multiple units are ganged in walls, devices shall be anchored by means of a tested grid.

J. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier

3.7 Waterproofing

A. Contractor is responsible for creating a waterproof seal in and around any openings to the outside environment that are created by Contractor or for systems being installed.

B. Contractor shall ensure that all waterproof materials meet appropriate codes and are applied according to good engineering practice.

3.8 Installation Requirements

A. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a “break-away”, or other approved method.

B. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of pathway entry and exit.

C. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.

D. All cable shall be free of tension at both ends.

E. PLENUM rated cable shall be used in areas used for air handling.

F. Contractor shall replace any cables that have been damaged or abraded during installation.

G. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

H. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit or surface mount raceway.

3.9 Equipment Installation

A. General: Contractor shall make system properly operational and physically secure by mounting equipment and related accessories into furniture, consoles, and racks as required. Manufacturer's guidelines for installation shall be followed. Discrepancies in installation procedure or inability to complete a given task due to a shortage of materials or malfunctioning equipment shall be reported to Consultant immediately upon discovery.

B. Equipment Placement: Contractor shall locate equipment as indicated on drawings and as specified herein. Where such information is not provided, follow industry best practices and locate operable devices at convenient positions; heat generating devices at the top and seldom-accessed equipment below.

1. Unless otherwise specified, end user-operable devices shall be positioned within the range of front wheelchair access per ADA standards.

C. Equipment Installation: Equipment shall be installed as directed by the manufacturer using equipment manufacturer's desktop mounting frames, equipment tubs, installation hardware, and techniques. Contractor shall be responsible for moving equipment from storage and for providing necessary personnel or devices to carry and lift equipment around obstacles and into operating position.

3.10 Rough-In

A. Scheduling: Contractor shall make every effort to install systems per this specification in a timely manner including rough-in of cabling and other apparatus where appropriate to stay on schedule.

B. Protection of Environment: Where cabling and/or equipment is installed prior to other trades completing their work in an area, Contractor shall take necessary precautions to cover, wrap, or otherwise protect to reduce possible damage due to plastering, painting, cleaning, or other such work.

3.11 Cutting, Drilling, Patching, and Painting

A. Coordination: Contractor is responsible for coordinating the work when any cutting or drilling is required in the performance of installing the specified systems.

B. Restoration: Contractor is responsible for returning all surfaces (including walls, floors, and ceilings) to their previous condition after any cutting.

3.12 Labeling

A. General: Rack-mounted equipment and hardware shall be labeled as required herein. Connectors, jacks, receptacles, outlets, cables, cable terminations, terminal blocks, rack mounted equipment, active slots of card frame systems, etc. shall be clearly, logically, and permanently labeled in a manner acceptable to Consultant.

B. Approval: Proposed wording and/or numbering schemes for labeling shall be provided to Consultant for review and written approval prior to procurement or installation.

C. Labels used shall be permanent and secure. Provide labeling as follows unless otherwise noted in a specific section:
   1. Like Size: Labels shall be sized to match other labels used for same purpose. Similarly, provide engraved labels of like size in other locations.
   2. Equipment Racks: For enclosed racks containing equipment, provide labels on each equipment rack rear door or console rear panel reading “No user serviceable parts. Refer service to qualified technician.”
   3. Installer and Consultant Identification: Position at the front top center section of each equipment rack a label that states the names of system Installer and Consultant.
   4. Custom Panels: Custom panel nomenclature shall be engraved, etched, or screened. Markings are to be designed to ensure consistency and clarity within and without of system. Verify markings and placements by submitting label sample layouts to Consultant for approval prior to procurement.
   5. Documentation: Labeling information shall appear on the as-built drawings.

3.13 Demolition

A. General: Where demolition is indicated in Project Documents, Contractor shall be responsible for removal, collection, transportation, and recycling of all indicated cabling and components, including the delivery of cable to the recycling center. If material is to remain on site for more than seven days after removal, Contractor shall coordinate with Owner for acceptable storage location.

B. Verification: Contractor shall field-verify existing conditions prior to beginning demolition work. Any discrepancies between existing conditions and Owner's written instructions shall be reported to Owner prior to the start of work in order to prevent disturbance of existing installation(s). Beginning work shall indicate acceptance of existing conditions. Contractor is responsible for immediately restoring any outages caused as a result of removing or damaging adjacent cabling, systems, or services.

C. Cable Removal: Where it is not possible to remove cables without damaging other cables that are to remain, such as in a shared conduit, Contractor shall cut cables at entry and exit point of constriction, leaving a minimum of 24" of cable at each end.

D. Cover Plates: Contractor shall provide and install blank cover plates for any outlets that are to be left in place and from which all cables have been removed. Cover plates shall match the Project standard color and finish.

3.14 Additional Engineering Services

A. General: Contractor is responsible for securing necessary engineering services where needed to meet the needs of the installation.

B. Change Orders: Only when Contractor can show that additional engineering services are needed as a result of changes to the scope of the services being requested will Owner entertain a Change Order for these services.

3.15 Grounding

A. All systems and equipment shall be grounded per manufacturer recommendations and TIA/EIA/BICSI 607 standards.

3.16 Warranty and Maintenance Program

A. Contractor shall provide the following warranty in addition to specific requirements identified in subsequent sections.

B. As part of the base proposal cost, the Proposer shall include a 15-year, system channel assurance warranty period with full support costs.

C. The Warranty period shall begin once the system is complete and all punch list items are confirmed as being complete per the construction documents. The Contractor shall receive a letter of completion from the Consultant and Owner once the project is complete starting the warranty period.

D. The warranty and support work included in this contract shall cover Labor, travel, equipment, materials and transportation cost.

E. Response Time: Response time for service calls.
   1. The Owner reserves the right to make the final determination of emergency or normal service calls and the right to coordinate the best times for service of any system failure.
   2. Emergency service calls are defined as failures that prohibit the use of a typical system function(s) that pose a life safety concern or such failures that create a major impact to the Owner's daily operations.
      a. The Contractor shall provide remote service diagnosing the impact within two (2) hours after notification by the Owner.
      b. If remote service does not correct the reported issue, the Contractor shall provide on-site service correcting the impact within four (4) hours after notification by the Owner.
   3. Normal service calls are defined as failures that prohibit the use of typical system function(s) that do not inhibit critical system usage, do not pose life safety concerns and do not create a major impact to Owner's daily operations.
      a. The Contractor shall provide remote service correcting the impact within twenty-four (24) hours after notification by the Owner.
   4. The Contractor shall supply Service Request forms and or proper contact procedure to the Owner with instructions for proper notification of the Contractor for warranty service. By following said instructions, the Owner shall constitute proper notification for any need warranty service

F. Repair Time: Contractor shall locally stock critical parts in sufficient quantities such that emergency repair or replacement shall be guaranteed within 12-hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality, and provided permanent replacement is achieved within 96 hours. Contractor may contact the Owner for use of Owner supplied spare parts where delay of system repair will have negative impact on system performance.

G. Transmittal: A copy of this Warranty shall be delivered to, and signed for by the Owner's representative whose primary responsibility is the operation and care of these systems. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.

H. Registration: Register Warranty papers for all equipment and software in the name of the Owner. Furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.

I. Subcontracting: Warranty service work may not be subcontracted except with specific permission and approval by the Owner.

J. Resolution of Conflicts

1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory, stating specific areas of dissatisfaction in writing.

K. If the Contractor or his approved Subcontractor does not resolve such stated areas of dissatisfaction within ninety-six (96) hours, the Owner may appoint an alternative service agency or person to fulfill the terms of the Warranty at the expense of the Contractor. This action may be taken repeatedly until the Owner is satisfied that Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed

END OF SECTION 27 05 00

SECTION 27 10 00 – COMMUNICATIONS CABLING GENERAL REQUIREMENTS

PART 1 - General

1.1 Scope

A. Each campus shall contain one MDF, typically within the Administration Building.

B. Connectivity to the MDF and between buildings shall be provided via underground duct bank. IDF rooms shall be allocated on each floor of each building. Contractor shall provide cable tray, conduit, or sleeves as detailed on the drawings.

C. IDF rooms are identified with the prefixes "IDF-1" and "IDF-2", followed by the architectural room number. An IDF-1 serves as the entrance facility for a building. Only one IDF-1 exists per building. Subsequent distribution in the building is routed through the IDF-2's. One or more IDF-2's are typically present on each floor. The Cabling Contractor shall build-out MDF and IDF-1 and IDF-2 space(s) as described within the Contract Drawings.

D. The Cabling Contractor shall provide and install equipment racks, enclosures and cabinets, cable runway, patch panels, wire managers, and miscellaneous hardware as shown on the drawings as part of the complete and working telecommunications cabling system.

E. Intra-building cable required to support network connectivity shall be installed within the plenum space, in conduit, duct and cable support accessories such as cable tray, cable ladder, surface mounted raceway, and/or power pole type assemblies

F. This section describes the products and execution requirements related to furnishing and installing Category 5e/6 Cabling and Termination Components and related subsystems as part of a Structured Cabling System.

G. Backbone system comprising copper and fiber optic cabling and horizontal (station) cabling is covered under this document.

H. Others will provide the network electronics for the LAN within the Telecom Rooms (TRs) and will be responsible for connecting the new cabling infrastructure to the LAN. This Contractor, however, shall supply the Category 6 patch cords. The Contractor shall be available on site during the crossover to assist with any cabling issues that may occur during the connection.

I. The Electrical Contractor shall install conduits and surface raceway for new technology outlet locations unless otherwise noted.

J. The Cabling Contractor shall provide and install all sleeves through the wall penetrations as required whether or not specifically marked on Project Drawings, unless otherwise noted.

K. All cables and related terminations support, and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in the following section(s).

L. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the TX Electrical Code, and present manufacturing standards.

M. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

N. A limited amount of broadband analog video distribution (CATV) cabling will be required as part of the SOW if identified on the drawings. In these instances, inter- building video signals are to be distributed via single-mode optical fiber cables and broadband coaxial cable using traditional CATV techniques within the buildings as defined on the project drawings. Plenum rated RG-6 coaxial cables shall be homerun from the serving area MDF, IDF-1, or IDF-2 to video outlet locations and installed within cable tray and/or conduit. All broadband distribution passive devices, labeling, testing and balancing, etc. shall be included as part of the Cabling Contractors SOW

1.2 Related Work

A. Section 27 00 00 – General Technology Requirements

B. Section 27 10 00 – Communications Cabling General Requirements

C. Section 27 10 05 – Grounding and Bonding for Technology Systems

D. Section 27 11 00 – Communications Equipment Rooms

E. Section 27 13 00 – Communications Backbone Cabling

F. Section 27 15 00 – Communications Horizontal Cabling

G. Section 27 16 00 – Communications Connecting Cords

H. Section 27 18 00 – Communications Labeling and Identification

1.3 Reference Standards and Codes

A. All references relate to the current version adopted by the city/county according to the authority having jurisdiction (AHJ). If the city/county has not adopted a version the latest version shall be utilized.

B. ASTM B633: Specification for Electrodeposited Coatings of Zinc on Iron and Steel

C. ASTM A653: Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process

D. ASTM A123: Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel

E. ASTM A510: Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

F. ANSI/TIA 569-C: Telecommunications Pathways and Spaces

G. ANSI/TIA 568-C.0, 1, 2, 3, 4: Commercial Building Telecommunications Standard

H. ANSI/TIA-598-C-2005 – Optical Fiber Cable Color Coding

I. ANSI/TIA 606-B: Administration Standard for Telecommunications Infrastructure

J. ANSI/TIA 942-A: Telecommunications Infrastructure Standard for Data Centers

K. ANSI/TIA 607-B: Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises

L. IEEE: National Electrical Safety Code® (NESC®) standards.ieee.org/about/nesc

1.4 Qualifications

A. Premises Distribution System: Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-C.0,1, 2, 3, EIA ANSI/TIA/EIA-569-B, and ANSI/TIA/EIA-606-A.

B. Materials and Equipment: Where materials or equipment are specified to conform, be constructed, or be tested to meet specific requirements, certification that the items provided conforms to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

C. Installers

1. All installing personnel shall have completed and be certified in manufacturer training or BICSI (Building Industry Consulting Service International) installation training for UTP infrastructure systems, or the Contractor shall contract with manufacturer for installation of all proposed components. Company Certifications shall accompany the proposal response.
2. The Contractor's technicians shall be certified and trained in the connectivity hardware that is being installed.

3. The Contractor shall submit certification that installers are factory certified to install and test the provided products. No less than half of the crew to be used for the telecommunications installation shall be trained by that manufacturer for the work.

1.5 Pre-Construction Submittals

A. Shop Drawings in addition to requirements in Section 27 00 00:
   1. Equipment rack elevation details
   2. Elevations of telecommunication room walls mounted equipment
   3. Outlet faceplate details for all outlet configurations, sizes, and cable types
   4. Overhead telecommunication room enlargements, provide dimensions of room and clearance for maintenance and operation

1.6 Closeout Submittals

A. Refer to Section 27 00 00 for requirements. In addition provide three (3) sets of the following:
   1. Data cable test results
   2. USB Drive containing:
      a. As-built drawings (AutoCAD format)
      b. As-built drawings (PDF format)
      c. Detailed test results in original tester format (Fluke Linkware)
      d. Detailed cable test results in PDF format
      e. Summary test results in PDF format
   3. Warranty certification from connectivity manufacturer

1.7 Delivery, Storage, and Handling

A. Vendor shall be responsible for all materials until completion of Project.

B. Cable shall be stored according to manufacturer's recommendations at minimum. In addition, cable shall be stored in a location protected from vandalism and weather.

C. If cable is stored outside, it shall be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees Fahrenheit, the cable shall be moved to a heated (minimum 50 degrees Fahrenheit) location. If necessary, cable shall be stored off site at the Contractor's expense.

D. If the Contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.

E. Commercial off-the-shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

PART 2 - Products

2.1 Substitutions

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

PART 3 - Execution

3.1 Warranty

A. Refer to Section 27 00 00 for additional requirements.

B. The Contractor shall provide to the Owner a manufacturer's 15 year minimum warranty certificate for all materials, equipment, etc. Upon successful completion of the installation and subsequent inspection, the Owner shall receive a numbered certificate, from the manufacturing connectivity hardware (patch panels, jacks, parch cords 110 blocks, etc.) company, registering the installation. This warranty shall include all labor, materials, and travel time.

C. The warranty shall ensure against product defects and guarantee that all approved cabling components exceed the specifications of TIA/EIA-568-C, and ISO/IEC IS 11801 for cabling links/channels, and that the installation will exceed the loss and bandwidth requirements of TIA/EIA 568-C ISO/IEC IS 11801 for fiber links/channels, for a fifteen (15) year period. The warranty shall apply to all passive structure cabling system components.

D. The warranty shall cover the failure of the wiring system to support the application that it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the TIA/EIA 568-C or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a minimum of a fifteen (15) year period.

E. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective products(s), labeling of the new components, and testing of the circuit(s) at no cost to the Owner.

3.2 Examination

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and timely completion.

B. Verify cable lengths comply with published standards.

C. Notify Owner of installation that would exceed maximum lengths prior to installation of cable.

D. Contactor shall consult with Owner regarding alternative routing or location of cable.

E. Do not proceed until unsatisfactory conditions have been corrected.

3.3 Spare Parts

A. Cable Spool(s) – Include 5% of base project total.

B. Cable Jacks – Include 5% of base project total.

C. Faceplates – Include 5% of base project total.

D. Patch Cords – Include 5% of base project total.

E. Patch Panels – Include 5% of base project total.

F. Contractor shall deliver 5% spare parts to Owner and receive sign-off that product was delivered and received.

3.4 Installation Requirements

A. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment shall include, but not be limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices that may move or wear in a manner to pose a hazard to the cable shall not be used.

B. Service Loops: A surplus of cable, typically located at or near the point of termination to facilitate potential future changes. Cables shall have a minimum cable slack of 10ft (3m) at the telecommunication room(s) and 3.28ft (1m) at each telecommunications outlet in the suspended ceiling unless noted otherwise. Service loops shall be stored in an extended loop or in a figure-eight configuration, not in bundled loops.

C. Cable Support (TIA 569-C.9.7):

1. Non-continuous supports shall be located at intervals not to exceed 1.5 m (5 ft). Non-continuous supports shall be selected to accommodate the immediate and anticipated quantity, weight, and performance requirements of cables.
2. It is recommended not to make long runs exactly 5 ft apart due to “harmonics” issues per cable manufacturers
3. Non-continuous pathways do not need to be bonded together or grounded (see 2011 NEC 250.92.A.1

D. Maximum pulling tension (TIA 568-C.5.3.1):
1. The pulling tension for a 4-pair balanced twisted pair cable shall not exceed 110 N (25 lbf) during installation. For multipair cable (12-pair and above), manufacturer’s pulling tension guidelines shall be followed.
2. Sags between supports shall be a maximum of 300 mm (12 inches).

3.5 Cooperation

A. The Contractor shall cooperate with other trades and General Contractor’s personnel in locating work in a proper manner.

B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

3.6 Testing and Acceptance

A. The Contractor shall perform acceptance tests as indicated below for each subsystem (backbone, station, etc.) as it is completed.

B. The Contractor shall supply all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type, including equipment to use, setup, test frequencies or wavelengths, results format, etc. The Consultant will approve the method of testing.

C. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The Contractor shall provide the Consultant with a written certification that this inspection has been made.

D. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Consultant. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall provide a minimum of one (1) week advance notice to the Consultant and Owner to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

E. Tests related to connected equipment of others shall be done only with the permission and presence of Contractor involved. The Contractor shall ascertain that testing only as required to prove the wiring connections are correct.

F. The Contractor shall provide test results and describe the conduct of the tests, including the date of the tests, the equipment used, and the procedures followed. At the request of the Consultant, the Contractor shall provide copies of the original test results.

G. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the Contractor's expense. The applicable tests shall then be repeated.

H. Backbone voice cables shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the termination blocks (e.g., 110). Any mispositioned pairs shall be identified and corrected. The percentage of "bad" pairs shall not exceed 1% in any backbone (riser or tie) cable based on total pair count. All bad pairs shall be identified and documented.

I. The Consultant or Owner may request that a 10% random field re-test be conducted on the cable system to verify documented findings.

J. If requested, the Contractor shall test up to 10% of cable links at no cost to the Owner.
   1. Tests shall be a repeat of those defined above and under Testing and Acceptance. If findings contradict the documentation submitted by the Contractor, additional testing shall be performed to the extent determined necessary by the Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.7 Fire Stopping

A. Contractor shall seal any openings created for cable pass-through between floors or through fire rated walls. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Creation of such openings as are necessary for cable passage between locations as shown on the Drawings shall be the responsibility of the Contractor. Any openings created by or for the Contractor and left unused shall also be sealed as part of this work.

C. Firestopping materials shall be asbestos free and capable of maintaining an effective barrier against flame, smoke, and gasses in compliance with requirements of ASTM E 814, and UL 1479. Only listed firestopping material acceptable to the City of San Antonio Fire Marshal shall be used within each of the following conditions:
   1. Duct, cables, conduit, piping, and cable tray penetrations through floor slab and through time-rated partitions or fire walls.

2. Openings between floor slab and curtain walls, including inside hollow curtain walls at the floor slab.
3. Penetrations of vertical service shafts.
4. Openings and penetrations in time-rated partitions of fire walls containing fire doors.
5. Locations where specifically shown on the drawings or where specified in other sections of the project manual.
6. The rating of the installed firestop system shall in no case less than the rating of the time-rated floor or wall assembly.

3.8 Acceptable Products.

A. Manufacturers acceptable contingent upon products' compliance with the specifications and City of San Antonio requirements:
   1. STI EZ-Path assemblies shall be used for all wall penetrations coming into an MDF or IDF rooms. Assemblies shall be sized to accommodate 50% growth over initial installation.
   2. 3M Brand Caulk CP-25, Putty 303, Wrap/Strip FS-195, Composite Strip CS-195, or Penetrating Sealing Systems 7900 Series.
   3. Dow Corning Fire Stop Foam, liquid component Part A (black) and liquid component Part B (off-white).
   4. Dow Corning Fire Stop Sealant.
   5. Fibrex Safing Insulation.

B. Damming Materials permitted are those products compatible with the above materials as certified by the manufacturer in their respective published data.

END OF SECTION 27 10 00

Division 27 – Communications

SECTION 27 10 05 – GROUNDING AND BONDING FOR TECHNOLOGY SYSTEMS

PART 1 - General

1.1 Scope

A. Refer to Section 27 00 00 for additional project scope information.

1.2 Related Work

A. General Technology Requirements

B. Communications Cabling General Requirements

C. Communications Equipment Rooms

D. Communications Backbone Cabling

E. Communications Horizontal Cabling

F. Communications Connecting Cords

G. Communications Labeling and Identification

1.3 Reference Standards and Codes

A. IEEE C2-2007 - National Electrical Safely Code

B. IEEE Std. 837-2002, or latest version – Standard for Qualifying Permanent Connections Used in Substation Grounding

C. ANSI/TIA-607-B-2011 - Commercial Building Grounding and Bonding Requirements for Telecommunications

D. NFPA 70E - Standard for Electrical Safely in the Workplace

E. ANSI/NECA/BICSI-607 - Telecommunications Bonding and Grounding Planning and Installation methods for Commercial Buildings

F. UL 467 - Standard for Grounding and Bonding Equipment

PART 2 - Products

Substitutions

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

B. Grounding and Bonding Cable

C. The grounding and bonding cable shall be solid stranded copper conductors. Gauge size as specified on project drawings or specifications.

D. The grounding and bonding cables shall have a green jacket color and riser or plenum rated as required.

E. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications, or as required by NFPA 70, whichever is larger. Differentiate between normal ground and isolated ground when both are used on the same facility.

2.2 Grounding and Bonding Busbars

A. Telecommunications Main Grounding Busbar (TMGB)
1. Factory-drilled solid copper with holes to accommodate lugs. Field manufactured busbars are not acceptable.
2. 0.25” thick x 4” wide
3. Sized for current applications and future growth
4. Insulated from its support
5. Shall be an electro-tin plated busbar
6. Maintain a minimum of 2” of clearance from wall
7. UL listed and BICSI certified

B. Telecommunications Grounding Busbar (TGB)
1. Factory-drilled solid copper with holes to accommodate lugs. Field manufactured busbars are not acceptable.
2. 0.25” thick x 2” wide
3. Sized for current applications and future growth
4. Insulated from its support
5. Shall be an electro-tin plated busbar
6. Maintain a minimum of 2” of clearance from wall
7. UL listed and BICSI certified

C. Horizontal Equipment Rack or Cabinet Busbar
1. Mounts to standard 19” Rack or Frame

2. Capacity: 6 Double hole lugs
3. Shall be an electro-tin plated busbar
4. UL listed and BICSI certified

D. Vertical Equipment Rack or Cabinet Busbar
1. Mounts to vertical rail or inside of cabinet in 19” or 23” equipment rack or frame.
2. Capacity: 9 Double hole lugs
3. Shall be an electro-tin plated busbar
4. UL listed and BICSI certified

E. Acceptable Manufacturers:
1. Chatsworth Products Inc (CPI)
2. Approved equivalent

F. Mechanical Connectors

G. Mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers, and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.

H. Split bolt connector types are not allowed.

I. Connectors shall meet or exceed UL 467.

2.3 Compression Lugs

A. Shall be UL & CSA listed

B. Shall meet or exceed the performance requirements of IEEE 837, latest revision

C. Compression type

D. Shall be manufactured from pure wrought copper. Conductivity of this material shall be no less than 99% by IACS standards.

E. Lugs shall be 2-hole. Single hole lugs are not allowed

F. Long barrel that will allow a minimum of two crimps with standard industry colors

G. Each connector shall be filled with an oxide-inhibiting compound

H. Crimped with a compression, tool and die system, according to manufacturer’s

I. recommendation

2.4 Taps

A. Connections to the Conductor shall be made with irreversible compression connectors

B. Shall be UL & CSA listed

C. Requires a minimum of (2) crimps for C Tap or H Tap, 1 crimp for I-Beam and busbar Tap

D. Crimp according to manufacturer's recommendation

PART 3 - Execution

3.1 General

A. Install products in accordance with manufacturer's instructions.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Mechanical connections shall be accessible for inspection and maintenance.

D. No insulation shall be installed over mechanical ground connections.

E. Ground connection surfaces shall be cleaned and all connections shall be made so that disconnection or removal is impossible.

3.2 Resistance Measurement

A. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms.

3.3 Telecommunications Bonding Backbone (TBB)

A. The intended function of a TBB is to reduce or equalize potential differences between telecommunications systems. While the TBB will carry some current under ac power ground fault conditions, it is not intended to provide the only ground fault return path.

B. The TBB shall:

1. Be connected to the TMGB & TGB connecting MDF and IDF rooms within the same structure. TGB shall not connect separate buildings.

2. Be a continuous copper conductor that shall be sized no less than 6 AWG to a maximum of 3/0 AWG. The TBB shall be sized in accordance to the following table:

Linear Length – ft.	Size (AWG)
Less than 13	6
14 - 20	4
21 - 26	3
27 - 33	2
34 - 41	1
42 - 52	1/0
53 - 66	2/0
Greater than 67’	3/0

3. The TBB conductors shall be installed and protected from physical and mechanical damage.
4. The TBB conductors should be installed with limited number of splices.
   a. Where splices are necessary, the number of splices should be kept to a minimum and they shall be accessible and located within telecommunications spaces or j-box labeled as a telecommunications bonding backbone splice.
   b. Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors or equal.

C. A metallic cable shield shall not be used as a TBB.

3.4 Grounding Equalizer (GE)

A. The GE shall be a continuous copper conductor that shall be sized no less than 6 AWG to a maximum of 3/0 AWG. The GE shall match the size of the TBB.

B. The GE shall connect to the telecommunications grounding busbar(s) in the same- floor telecommunications rooms on the first, top, and every third floor in a building greater than 4 floors.

C. A metallic cable shield shall not be used as a GE.

3.5 Telecommunications Equipment Bonding Conductor (TEBC)

A. Connects the TMGB/TGB to equipment racks and cabinets.

B. Shall be a continuous copper conductor that shall be sized per the length of cable.

C. Shall be separated from ferrous materials by 2” or be bonded to the ferrous metal.

D. May be routed within cable trays or suspended 2” under or off the side of the cable tray or ladder rack.

E. Shall be supported every 3ft.

F. 8” minimum bend radius.

G. May come cross other cable groups at a 90 degree angle only.

H. A metallic cable shield shall not be used as a TEBC.

3.6 Rack or Cabinet Bonding Conductor

A. A bonding conductor shall be used to connect the equipment racks and cabinets directly to the TMGB, TGB or underfloor ground mesh network.

B. All metallic enclosures, including remote mounted equipment cabinets and racks for telecommunications, security or audio/visual shall be bonded to the nearest TMGB or TGB using a minimum sized conductor of 6 AWG. Remote bonds shall be labeled on both ends stating the destination of the bond.

3.7 Electrical Distribution Panel (EDP)

A. The AC EDP serving the Telecommunications Room shall be bonded to the TMGB or TGB using a minimum of a 6 AWG cable.

B. A qualified electrician shall make all connections within an AC electrical distribution panel.

3.8 Optical Fiber Conductive Cables

A. Conductive fiber-optic cables should be bonded and grounded as specified in the NEC.

3.9 Ladder Rack and/or Cable Tray

A. All low voltage cable runway sections shall be bonded together and bonded back to the nearest Telecommunications Room the runway is serving as close TMGB or TGB as practical.

B. Maintain an 8” minimum bend radius on the TEBC.

C. Keep a 2” separation from other cables both power and telecommunications.

D. Remove any paint, oxidation, etc. from the runway surfaces that are being bonded.

E. Drill two holes as required to accommodate the 2-hole compression lug.

F. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.

G. Attach straps to the runway using stainless steel hardware sized for the lug holes.

H. Wipe off any excess antioxidant after installation of the lug.

3.10 Labeling

A. Each grounding/bonding cable shall be labeled at the TMGB or TGB.

B. All taps to the TBB shall be within an enclosure and labeled as to its purpose.

3.11 Testing

A. Refer to Section 27 00 00 for additional requirements.

B. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION 27 10 05

SECTION 27 11 00 – COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - General

1.1 Scope

A. Refer to Section 27 00 00 for additional project scope information.

B. This section describes the products and execution requirements relating to telecommunications cabling, termination components, racks, pathways, telecommunication rooms and related subsystems. Covered systems include the following:
   1. Equipment room cable management system and equipment racks
   2. Horizontal and backbone cable terminating equipment
   3. Telecommunications grounds and related components

1.2 Related Work

A. General Technology Requirements

B. Pathways for Technology Systems

C. Communications Cabling General Requirements

D. Grounding and Bonding for Technology Systems

E. Communications Backbone Cabling

F. Communications Horizontal Cabling

G. Communications Connecting Cords

H. Communications Labeling and Identification

PART 2 - Products

2.1 Substitutions

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.2 Category 6 Patch Panels

A. Standard Data Cables shall be terminated at the telecommunication rooms on high- density integrated patch panels incorporating Category 6 jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet detailed in the section above.

B. Patch panel configuration shall be 48 ports.

C. The patch panel shall exceed ANSI/TIA/EIA 568-C.2-1 Category 6 component compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.

D. The patch panels shall be interoperable and backwards compatible to lower performing cabling systems.

E. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers' minimum bend radius specifications are adhered to.

F. The patch panel shall have color-coded designation strips to identify cable count.

G. Manufacturers:
1. Leviton 69586-U48

2.3 Category 6a Patch Panels

A. All specialty cables (WAPS, UPLINK) shall be terminated at the telecommunication closets on high-density integrated patch panels incorporating Category 6a jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet detailed in the section above. Specialty cable shall not be mixed with standard data cables within the patch panels.

B. Patch panel configuration shall be 48 ports.

C. The patch panel shall exceed ANSI/TIA/EIA 568-C.2-1 Category 6a component compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.

D. The patch panels shall be interoperable and backwards compatible to lower performing cabling systems.

E. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers' minimum bend radius specifications are adhered to.

F. The patch panel shall have color-coded designation strips to identify cable count.

G. Manufacturers:
1. Leviton 6A586-U48

2.4 Voice Backbone Termination Field

A. Wall Mounted 110 Blocks
1. At the MDF room, voice "backbone" cables shall be terminated on high-density wall mounted 110 blocks.
2. The Proposer shall provide 100 pairs rack mounted 110 panels. The panel shall allow voice backbone cables to be terminated directly on the wall.
3. The panels shall incorporate the openings between rows to allow cables to be routed from behind the panel directly to the point of termination.
4. The panels shall be with cable managers and covers. Termination strips on the base shall be notched and divided into 5-pair increments.
5. The mechanical termination shall:
   a. Have the ability of terminating 22-26 AWG plastic insulated, solid, and stranded copper conductors.
   b. Provide a direct connection between the cable and jumper wires.
   c. Have less than 0.2-dB of attenuation from 1 - 100 MHz.
   d. Have less than 100 mw of DC resistance.
   e. Have less than 5 mw of resistance imbalance.
   f. Have minimal signal impairments at all frequencies up to 100 MHz.
6. Blocks shall identify pair position by a color designation: blue, orange, green, brown, and slate (backbone only).
7. OSP Protectors shall be solid-state type units for all cable pairs to be used for data transmission; Circa 3B1S-300 or approved equivalent.
8. Interior backbone 110 panels shall be Leviton 41AW1-50 or equal.

2.5 Fiber Optic Patch Panels

A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.

B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types, including SC, ST, Fixed Shroud Duplex (e.g., "FDDI Connector"), Biconic, and FC by changing panels on which connector couplings are mounted.

C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.

D. The Contractor shall provide all required connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated.

E. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.

F. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

G. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.

H. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.

I. All patch panels shall provide protection to both the "facilities" and "user" side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.

J. Where singlemode fibers are installed, the fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies ("pigtails") or (2) use of a "fan-out" kit. In the latter approach, individual fibers are to be secured in a protective covering (such as an Aramid reinforced tube, for example) with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and subassemblies are secured to prevent damage. Splicing shall be by the "fusion" method. Individual splice loss shall not exceed 0.2 dB.

K. Fiber optic patch panels shall be:
   1. Leviton 5R2UH-S06 in IDF rooms.
   2. Leviton 5R4UH-S12 in MDF or Server Rooms.

L. 50-micron LC adaptor panels shall be Leviton SDX 12-port Aqua #5F100-2QL.

M. Single mode LC adaptor panels shall be Leviton SDX 12-port Blue #5F100-2LL.

2.6 Cable Management System

A. The cable management system shall be used to provide a neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures. The system shall be a complete cable management system comprising 4-post and 2-post floor mount racks, wall mount racks, equipment cabinets and vertical and horizontal cable managers to manage cables on both the front and rear of the rack. The system shall protect network investment by maintaining system performance, controlling cable bend radius, and providing cable strain relief.

1. 2-Post Equipment Racks
   a. The Contractor shall provide and install 2-post adjustable equipment racks to house cable termination components (e.g., copper data and fiber optic) and network electronics (by others) as shown on the drawings. Prior to installation, the Contractor shall coordinate exact placement with Owner.
   b. Rack shall be 84" in height and shall be self-supporting.
   c. Channel uprights shall be spaced to accommodate industry standard 19" mounting and have pass-through holes with smooth edges to protect cables.
   d. Rack shall be constructed of aluminum.
   e. Rack shall be double side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per EIA/TIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets.
   f. Rack shall be supplied with at least 24 spare screws.
   g. Rack shall be supplied with a ground bar and #6 AWG ground lug.
   h. Manufacturers:
      1) Chatsworth #55053-703
      2) Approved equal.

B. Vertical Cable Management
1. At the telecommunication rooms, vertical cable management shall be furnished and installed to adjacent racks to organize cables on front and rear of telecommunication racks.
2. Vertical cable managers shall include components that aid in routing, managing, and organizing cable to and from equipment. Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief. Panels shall be a universal design mounting to EIA 19" or 23" racks.
3. Vertical cable management system shall feature the following:
   a. Open cabling section on the rear that provides easy access and routes cable bundles feeding into the back of patch panels and 1 RMU cable guide on the front designed for fanning and managing patch cords.
   b. Edge-protected pass-through ports designed for easy routing of cable from front channel to back.
   c. Vertical slots along the center separator to allow securing cable bundles neatly with management straps.
   d. Door/cover (front only) that is easily opened from the right or left and still easily removed to allow for quick moves, adds, and changes.

e. Movable wire retainers to retain the cables during cover removal.

4. Vertical cable management at the end of rack rows shall be 6”.
5. Vertical cable management between racks shall be 10”
6. Manufacturers:
   a. Chatsworth Products Industries (CPI) 13902-703 & 13904-703
   b. Approved equal

2.7 Power Devices

A. Refer to Section 27 00 00 for additional requirements.
B. Power strip shall provide surge protection and power conditioning.
C. Contractor shall provide one (1) power strip per rack/cabinet.
D. Manufacturers:
   1. APC
   2. Or approved equal

2.8 Horizontal Cable Management

A. Horizontal cable managers shall include components that aid in routing, managing, and organizing cable to and from equipment. Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief. Panels shall be a universal design mounting to EIA 19" racks and constructed of steel bases with PVC duct attached. The duct fingers shall include retaining tabs to retain the cables in place during cover removal. The covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.

B. The cable managers shall be provided with movable wire retainers to retain the cables during cover removal and #12-24 mounting screws. An integral strain relief bracket shall be provided on either end of the duct to allow for easy cover placement.

C. Double-Sided horizontal cable managers shall be placed above and below each patch panel.

D. The Contractor shall also supply (1) additional manager for every horizontal patch panel installed for network electronics (electronics provided by others).

E. Manufacturers
   1. Chatsworth Products Industries (CPI) #13930-702
   2. Cooper/B-Line
   3. Approved equal

2.9 Telecommunication Ground

A. The Telecommunication Contractor is responsible for providing an appropriate ground for all racks, trays, and telecommunications equipment installed by this Contractor.

2.10 Wire Basket Runway Tray

A. Within each Telecommunications Room, the Contractor shall provide and install sufficient wire basket tray to support cable bundles from corridor to equipment racks or as shown on the Project Drawings, this Contractor shall provide and install sufficient basket tray to support cable bundles from corridor to equipment racks or cabinets.

B. The Contractor shall provide all necessary labor, supervision, materials, equipment, tests, and services to install complete wire basket runway systems in the telecommunication closet.

C. Wire basket runway systems shall include, but are not limited to, straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports, and accessories.

D. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances, and levels will be governed by actual field conditions.

E. All straight section longitudinal wires shall be straight (with no bends).

F. Wire basket runway shall be made of high strength steel wires and formed into a standard 2-inch by 4-inch wire mesh pattern with intersecting wires welded together. All wire ends along runway sides (flanges) shall be rounded during manufacturing for safety of cables and installers.

G. All fittings shall be field formed as needed.

H. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 stainless steel. Splicing assemblies shall provide a continuous ground connection.

I. Wire Basket Tray shall be grounded to the Telecommunications Room ground bus bar.

J. Construction: Overhead Cable Management shall be 18-inch (MDF) or 12-inch (IDF) Universal Cable Runway made of 3/8” x 1-1/2” x .065” wall rectangular steel tubing with cross members welded at 12 inch intervals. Cable Runway shall be installed utilizing appropriate hardware to support, join, or attach sections to structures, and shall be supported at a minimum of 5 foot intervals.

K. Acceptable Manufacturers:
   1. Chatsworth Products Industries (CPI)
   2. Cooper/B-Line
   3. Approved equivalent

L. Cable Drop Out/Waterfall
   1. Where cables bundles transition from tray and drop to the rack, cabinets or ladder rack, the Contractor shall provide and install a radius control device. This device shall be a waterfall or drop out device and shall be properly sized to accommodate cable bundle plus 20% future growth.

M. T-sections of tray shall be made using T-section fittings.

N. Straight section splices shall be made using splice plates.

O. Wire basket runway supports shall be wall mounted brackets and trapeze hangers when spanning the room.

P. Trapeze hangers shall be supported by 3/8 inch diameter rods.

Q. Provide size as indicated on the drawings.

R. Tray shall have flat Black finish.

S. Accessories (connectors, splice plates…) shall be painted to match tray finish.

T. Acceptable Manufacturers:
1. Chatsworth Products Industries (CPI)
2. Cooper/B-Line
3. Approved equivalent

2.11 Ladder Rack

A. Within each Telecommunications Room, the Contractor shall provide and install ladder rack as shown on the Project Drawings.

B. Within each Telecommunications Room with a vertical conduit riser the Contractor shall provide and install vertical ladder rack connecting the ground conduit sleeve penetrations with the ceiling conduit sleeve penetrations.

C. The Contractor shall provide all necessary labor, supervision, materials, equipment, tests, and services to install a complete ladder rack system in the telecommunications room as shown on the Drawings.

D. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances, and levels will be governed by actual field conditions.

E. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 stainless steel.

F. Cable Drop Out/Waterfall
1. Where cables bundles transition from tray and drop into the racks/cabinets, the Contractor shall provide and install a radius control device. This device shall be a waterfall or drop out device and shall be properly sized to accommodate cable bundle plus 20% future growth.

G. Size ladder rack as indicated on the Contract Documents.

H. Accessories (connectors, splice plates…) shall be painted to match tray finish.

I. Manufacturers:
1. Chatsworth Products Industries (CPI)
2. Cooper/B-Line
3. Approved equal

PART 3 - Execution

3.1 Equipment Rack and Cabinets

A. Prior to permanently securing racks or cabinets, the Contractor shall coordinate a walk through with the Owner to determine exact placement of racks.

B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. Rack shall also be stabilized by extending a brace extending to the wall. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

C. A space between the rack upright and the wall (~6") shall be planned to allow for cabling in that area. The rear of the rack shall be ~40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed shall be brought to the attention of the Consultant for resolution prior to installation.

D. All hardware and equipment is to be mounted at least 18" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware shall be reviewed and approved by the Consultant and Site Coordinator(s) prior to installation.

E. Equipment rack shall be equipped with cable management hardware to allow an orderly and secure routing of twisted pair cabling to the data patch panels. At minimum, one such horizontal jumper management panel shall be placed below each fiber optic patch panel installed by the Contractor. Additional jumper management panels may be required pending installation of other cable types on the rack. The rack shall be grounded to the telecommunications ground (TGB) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket).

3.2 Wire Basket Tray and Ladder Rack Runway

A. Runway shall be installed in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of NEC, applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

B. Coordinate installation of runway with other electrical work as necessary to properly interface installation of wire basket runway with other work.

C. Provide sufficient space encompassing runways to permit access for installing and maintaining cables.

D. Test runways to ensure electrical continuity of bonding and grounding connections and to demonstrate compliance with specified maximum grounding resistance.

END OF SECTION 27 11 00

SECTION 27 13 00 – COMMUNICATIONS BACKBONE CABLING

PART 1 - General

1.1 Scope

A. Refer to Section 27 00 00 for additional project scope information.

B. This section describes the products and execution requirements relating to telecommunications voice, data and video backbone cabling and termination components.

C. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable types:
   1. 50-micron Multimode Fiber Optic Cable
   2. Singlemode Fiber Optic Cable
   3. Multi-Pair Copper Voice Backbone Cable

1.2 Related Work

A. General Technology Requirements

B. Pathways for Technology Systems

C. Communications Cabling General Requirements

D. Grounding and Bonding for Technology Systems

E. Communications Equipment Rooms

F. Communications Horizontal Cabling

G. Communications Connecting Cords

H. Communications Labeling and Identification

1.3 Test Data – Fiber Optic Media

A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.

B. The test result records saved by the tester shall be transferred into a Windows- based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
   1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
   2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
   3. The date and time the test results were saved in the memory of the tester.

E. The following general information is to be provided in the electronic database containing the test result information for each link:
   1. The identification of the customer site as specified by the end user.
   2. The overall Pass/Fail evaluation of the link-under-test.
   3. The name of the standard selected to execute the stored test results.
   4. The cable type and the value of the ‘index of refraction’ used for lengthcalculations.
   5. The date and time the test results were saved in the memory of the tester.
   6. The brand name, model, and serial number of the tester.
   7. The revision of the tester software and the revision of the test standards database in the tester.

F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:
   1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
   2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).

G. The link length shall be reported for each optical fiber for which the test limit was calculated.

H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.

I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document.

J. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (“.dwg”,

AutoCAD rel. 2004 and ".dxf") formats on which as-built construction information can be added. These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.

K. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (AutoCAD rel. 2004 and ".dxf") form.

PART 2 - Products

2.1 Substitutions

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.2 Backbone Voice Cabling

A. The voice backbone cable shall link the Main Closet and Telecommunications Rooms serving the building. The cables shall be CMP rated. These cables shall be terminated on rack mounted 110 type blocks at MER and TR.

B. Voice backbone cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene. Conductors shall be twisted to form pairs and fully color-coded.

C. The voice backbone cable shall be sized as detailed on the Drawings.

D. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with ICEA publication S-80-576-1988. Marking of each mate of the primary conductor in a pair with the color of that primary conductor is optional.

E. The voice backbone cable shall meet or exceed the EIA/TIA Category 3 performance requirements.

F. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair subunits, each color-coded in accordance with ICEA publication S-80-576- 1988. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow, and violet. Binder color code integrity shall be maintained wherever cables are spliced.

G. All cables and equipment shall be furnished, installed, wired, and tested by the Contractor.

H. Acceptable Manufacturers:
1. Berk-Tek, General, Hitachi

2. Or Approved Equivalent.

2.3 Intra-building Backbone Copper Cabling

A. General: Copper backbone cable shall be used to provide voice connectivity between the MDF or IDF-1 and IDF-2 Spaces. Cable shall be installed within conduits, sleeves/cores and/or the cable tray system between spaces.

B. Codes and standards: Multi-conductor cable shall be acceptable for IEEE 802.3 applications. Cables shall be type CMP (communications plenum cable) or type CMR (communications riser cable) as required per the installation environment and as outlined in NEC Sections 800-51(a) and 800-51(b) respectively. Cable shall also conform to Bell Laboratories specification L-780011 and be UL listed.

C. Conductors: Conductors shall be #24 AWG solid annealed copper twisted to form individual non-shielded pairs. The twisted pairs shall be color-coded using standard telephone industry color codes.

D. Insulation: Polyvinylchloride skin over polyethylene or a Teflon material as required per the installation.

E. Jacket: Riser rated cable jacket shall be of fire resistant riser rated material equivalent to polyvinylchloride plastic or better. Cable jacket shall enclose an overlapped corrugated aluminum shield. Plenum rated cable jacket shall be of fire resistant plenum rated material equivalent to a copolymer or better.

F. The total number of cable pairs supplied in each run shall equal the total pair count as shown on the drawings.

G. Acceptable Manufacturer/Product:
1. Berk-Tek, General, Hitachi
2. Or Approved Equivalent.

2.4 Outside Plant (OSP) Inter-building Fiber Optic Cable

A. General: Loose tube fiber optic backbone cable shall be used for connectivity between buildings. Cable will be run within innerduct in underground conduit between buildings and within the building.

B. Fiber construction shall consist of both single mode OM4 multi-mode with a core/cladding size of 9/125 micron single mode and 50.0/125 micron multi-mode in a composite cable. Contractor shall furnish and install the appropriate fan out or breakout materials as required and dictated by the application and fiber optic cable type.

C. The total number of fibers supplied in each cable run shall equal the total number of fibers shown on the contract drawings. The cable structure shall be such that the fibers are grouped for easy handling. The cable shall contain appropriate strength members to satisfy the mechanical and environmental specifications provided herein.

D. The core shall consist of filled buffer tubes surrounding a central dielectric strength member. Water-Swellable and Flame Retardant Tape and yarns shall surround the fibers to provide further weather and mechanical protection. The Contractor shall ensure that the core construction of the cable proposed for installation is such that the environmental and mechanical requirements of the installation are met.

E. The maximum attenuation of loose tube fiber optic strands shall be:

1. 50.0/125 multi-mode (850 nanometers): 3.0 dB/km (1300 nanometers): 1.0 dB/km
2. 9.0/125 single-mode (1310 nanometers): 0.4 dB/km (1550 nanometers): 0.3 dB/km

F. The minimum OFL bandwidth of OM3 multi-mode cable shall not be less than 1500 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

G. The minimum OFL bandwidth of OM4 multi-mode cable shall not be less than 3000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

H. The minimum Laser bandwidth of OM3 multi-mode cable shall not be less than 2000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

I. The minimum Laser bandwidth of OM4 multi-mode cable shall not be less than 4700 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

J. All finished fibers must be color-coded by the manufacturer for identification. The fibers shall be connectorized utilizing field-installed terminations or spliced pigtails. The nominal connector loss using either termination method shall not be greater than 0.40 dB per mated pair.

K. The fiber cable shall be able to withstand a short-term tensile load of 2700 N (600 lbf.) and a long-term tensile load of 600 N (135 lbf.) with maximum elongation of less than 0.5% and no breakage of fibers.

L. The minimum static or no load (0-180 lb.) bending radius for the cable shall be no less than 10 times the outside diameter of the cable. Cables shall be able to withstand being flexed at their minimum static bending radius +/- 90 degrees for at least 20 cycles at 20-40 cycles per minute at 20 degrees C. The minimum dynamic or loaded (181-600 lb.) bending radius shall be no greater than 20 times the outside diameter of the cable.

M. The cable shall be able to withstand twisting of +/-360 degrees over a length of 2 meters for at least 10 cycles at 10 cycles per minute. The cable shall be able to withstand storage and operating temperatures of -40 to +70 degrees C. The cable shall withstand a compressive force of 600 N/cm without breakage, and there shall be no attenuation increase after the force is removed.

N. Acceptable Product:
1. Berktek
2. General
3. Hitachi
4. Or Approved equivalent

2.5 Tight-Buffered Optical Fiber Cables for Indoor Distribution Applications

A. General Considerations
1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.
2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).
3. Cables shall be listed OFNP (OFCP).
   a. Berktek
   b. General
   c. Hitachi
   d. Approved equivalent.
4. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) Standard for Fiber Optic Premises Distribution Cable (ICEA S-83-596).

B. Cable Construction
1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be 900 ±50µm. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
2. Cables with 2 to 24 fibers layered aramid yarns shall serve as the tensile strength member of the cable.
3. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
4. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
5. The fibers shall be stranded around a dielectric central member.
6. For cables containing 12-24 fibers, the fibers shall be arranged in two layers.
7. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the 900 µm buffered fibers.
8. Cables with 24 to 60 fibers shall have unitized riser and plenum constructions.
9. The buffered fibers shall be grouped in six-fiber subunits.
10. The fibers shall be stranded around a dielectric central member in the subunit.
11. Layered aramid yarns shall serve as the tensile strength member of the subunit.

12. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
13. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
14. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.

C. Outer Cable Jacket

1. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
2. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. The interlocking armor for plenum cables shall have a PVC jacket.
3. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit.

D. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B “Optical Fiber Cable Color Coding.” The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.
2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be orange for subunits containing multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.
3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket. The cable jacket color shall be orange for cables containing multimode fibers and yellow for cables containing singlemode fibers.

4. Cables with a PVC jacket over interlocking armor shall be marked with the manufacturer name, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket. The cable jacket color shall match the color of the core optical fiber cable.

E. Cable Specifications

1. Temperature Range
   a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70ºC. The installation/operating temperature range for riser cables shall be -20 to +70 ºC. Testing shall be in accordance with FOTP- 3.
   b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70ºC.The installation/operating temperature range for plenum cables shall be 0 to +70ºC.Testing shall be in accordance with FOTP-3.
2. Compressive Load Resistance
   a. When tested in accordance with FOTP-41, Compressive Loading Resistance of Fiber Optic Cables, the cable shall withstand a minimum compressive load of 89 N/cm (50 lbf/in) applied uniformly over the length of the compression plate. While under compressive load, the fiber shall not experience an attenuation change greater than 0.4 dB at 1550 nm (singlemode) or greater than 0.6 dB at 1300 nm (multimode). After the compressive load is removed, the fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
3. Cyclic Flexing
   a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
4. High and Low Temperature Bend
   a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 ºC and +50 ºC. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).
5. Impact Resistance
   a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
6. Temperature Cycling
   a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 ºC) shall not

exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.

7. Twist-Bend
   a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).

F. Multimode (50/125 µm)
1. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA- 492AAAA-A-1997, Detail Specification for 50µm Core Diameter/125µm Cladding Diameter Class Ia Graded- Index Multimode Optical Fibers (OM4 type). Cable shall have the following specifications:
   a. Core Diameter: 50 ± 3 µm
   b. Core Non-Circularity: ≤5%
   c. Cladding Diameter: 125± 2 µm
   d. Cladding Non-Circularity: <2.0%
   e. Core-to-Cladding Concentricity: ≤ 3 µm
   f. Coating Diameter: 245 ± 2 mm
   g. Refractive Index Profile: Graded index
   h. Numerical Aperture: 0.275 ± 0.015
   i. Maximum Attenuation: less than 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
2. IEEE 802.3z Performance: The fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation for up to 500 meters.
3. Attenuation at the Water Peak: The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km.
4. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75-
5. ± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or1300 nm.

G. Singlemode
1. The singlemode fiber utilized in the optical fiber cable shall meet EIA/TIA- 492CAAA, Detail Specification for Class IVa Dispersion-Unshifted Singlemode Optical Fibers, and ITU recommendation G.652, Characteristics of Singlemode Optical Fiber Cable. The cable shall meet the following specifications:
   a. Core Diameter (Characterized): 8.3 µm
   b. Cladding Diameter: 125. ±1.0µm
   c. Core-to-Cladding Concentricity: ≤ 0.8 µm
   d. Cladding Non-Circularity: ≤1.0 %
   e. Coating Diameter: 245 ±10µm
2. Attenuation: The maximum attenuation shall be 0.5 dB/km at 1310 nm and 0.4 dB/km at 1550 nm.
3. Attenuation Uniformity: There shall be no point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.

4. Attenuation at the Water Peak: The attenuation at 1383 ± 3 nm shall not exceed 2.1dB/km.
5. Cutoff Wavelength: The cabled fiber cutoff wavelength shall be ≤1260 nm.
6. IEEE 802.3z Performance: The fiber shall support laser-based Gigabit Ethernet (GbE) operation in the 1000BASE-LX (1300 nm) operating window at 5000 m.
7. Mode Field Diameter: The mode field diameter of the fiber shall be 9.30 ±0.50µm at 1310 nm 10.50 ±1.0µm at 1550 nm.
8. 12 Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75-± 2mm diameter mandrel shall not exceed 0.05 dB at 1310 nm and 0.10 dB at 1550 nm.
9. Zero Dispersion Wavelength (∂o): The zero dispersion wavelength of the fiber shall be 1301.5 nm ≤ ∂o ≤ 1321.5 nm.
10. Zero Dispersion Slope (So): The zero dispersion slope of the fiber shall be ≤0.092 ps/(nm•km).
11. Maximum Dispersion: The maximum dispersion shall be ≤ 3.2 ps/(nm•km) from 1285 nm through 1330 nm and shall be ≤18 ps/(nm•km) at 1550 nm.

H. The cable shall be Berk-Tek, Corning, General, Mohawk or other equivalent products that meet these specifications.

2.6 Fiber Optic Connector

A. The optical connector shall be LC-type.

B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.

C. The connector shall meet the following performance criteria:
1. Cable Retention (FOTP-6) 0.2 dB
2. Durability (FOTP-21) 0.2 dB
3. Impact (FOTP-2) 0.2 dB
4. Thermal Shock (FOTP-3)0.2 dB
5. Humidity (FOTP-5) 0.2 dB

D. Connectors shall be Leviton field polished, 3M Hot Melt or other approved connector.

PART 3 - Execution

3.1 Testing

A. Refer to Section 27 00 00 for additional requirements.

B. Field Test Requirements for Fiber Optic Cabling System

1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include the manufacturer's on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.
6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
   a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
   b. The manufacturer of the test equipment used for the field certification
   c. Training organizations authorized by BICSI
7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
8. Field test instruments for singlemode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7.
9. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
10. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
11. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
12. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

13. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
14. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.

C. Fiber Performance Test Parameters

1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.
   a. Link Attenuation = Cable_Attn + Connector_Attn + Splice_Attn
   b. Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
   c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 50/125 µm	**850**	**3.5**
	1300	**1.5**
Singlemode (Inside plant)	**1310**	**0.5**
	1550	**0.4**
Singlemode (Outside plant)	**1310**	**0.4**
	1550	**0.5**

   d. Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)
   e. Maximum allowable mated connectors loss = 0.50 dB
   f. Splice_Attn (dB) = number of splices (S) * splice_loss (dB)
   g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)
2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
5. The backbone link (multimode/singlemode) shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
7. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.

8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.
9. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1. All singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm.

3.2 Fiber Optic Cable Installation Requirements

A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.

C. Exact cable termination locations shall be field verified with Owner.

END OF SECTION 27 13 00

SECTION 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - General

1.1 Scope

A. This section describes the products and execution requirements relating to telecommunications voice, data and video horizontal (station) cabling and termination components.

B. Horizontal cabling is the cabling between the work area telecommunications outlet and the telecommunications room (TR). Horizontal cabling is often referred to as “station cabling”.

C. The horizontal cabling system will consist of the following:
1. Unshielded Twisted Pair (UTP) Cable
2. Outlet Termination Modules (jacks)
3. Outlet Termination Plates
4. Horizontal Fiber Optic/Copper Composite Cabling
5. Above Ceiling Cable Support Systems
6. Horizontal Cable Testing Requirements
7. Cable Pathway/Sleeve Requirements
8. Coaxial Cable

1.2 Related Work

A. Section 27 05 23 – Pathways for Technology Systems

B. Section 27 00 00 – General Technology Requirements

C. Section 27 10 00 – Communications Cabling General Requirements

D. Section 27 10 05 – Grounding and Bonding for Technology Systems

E. Section 27 11 00 – Communications Equipment Rooms

F. Section 27 13 00 – Communications Backbone Cabling

G. Section 27 16 00 – Communications Connecting Cords

H. Section 27 18 00 – Communications Labeling and Identification

PART 2 - Products

2.1 Substitutions

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.2 Category 6 Horizontal Copper Cables (standard data cables)

A. All cables and equipment shall be furnished, tested, installed and wired by the Contractor.

B. All horizontal data cables shall terminate on modular patch panels in the telecommunications rooms as specified on the Drawings.

C. Standard data cable specification defines the requirements for commercially available high performance Category 6 cable.

D. This cable shall be suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.

E. Standard data cable design described herein shall exceed transmission performance of Category 6 cables.

F. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.

G. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by the Contractor.

H. The jacket color for data cables shall be BLUE.

I. IMPORTANT: Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.

J. Category 6 Cables shall be:
   1. Berk-Tek - LANmark 1000
   2. General Cable – Genspeed 6000
   3. Or Hitachi – Supra 660

2.3 Category 6A Horizontal Copper Cables (WAP and Up-Links)

A. Category 6A cables shall be used to support all Wireless Access Point (WAP) and all Uplink connections connecting MDF/IDF rooms. All cables and equipment shall be furnished, tested, installed and wired by the Contractor.

B. All horizontal data cables shall terminate on modular patch panels in the telecommunications rooms as specified on the Drawings.

C. WAP and Uplink cable specification defines the requirements for commercially available high performance Category 6A cable.

D. This cable shall be suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.

E. WAP and Uplink cable design described herein shall exceed transmission performance of Category 6A cables.

F. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.

G. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by the Contractor.

H. The jacket color for data cables shall be BLUE.

I. IMPORTANT: Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.

J. Category 6A Cables shall be:
1. Berk-Tek – LANmark-10G2
2. General Cable – Genspeed 10 MTP Thin-Profile
3. Or Hitachi – Supra 10G

2.4 Coaxial Cable (when applicable)

A. RG-6 Quad Shield Coaxial Station Drop Cable
1. RG-6 coaxial cable shall be used for video connectivity from the video system main trunk cable to the individual CATV or broadcast outlet. The cable shall be placed within the cable tray system and shall be UL Listed CMP Plenum rated.

2. Center conductor shall be nominal 18AWG minimum, solid bare copper. The dielectric insulation shall be foam FEP. The outer conductor or shield shall be aluminum foil and 95% coverage tinned copper braid. Outer jacket shall be CommFlex V with minimum 80 degree Celsius temperature rating and white in color.
3. Maximum attenuation of the cable @ 20degrees Celsius shall be 6.05dB/100feet @ 720MHz. Velocity of Propagation shall be 84% NOMINAL. Nominal impedance shall be 75Ω 2Ω.
4. Acceptable Product:
   a. General Cable
   b. Belden

2.5 Information Outlet

A. General
1. Station cables shall each be terminated at their designated workstation location in the connector types described in the subsections below. Included are modular jacks, faceplates, and surface mount raceway. The combined assembly is referred to as the Standard Information Outlet (SIO). These connector assemblies shall snap into a mounting frame.
2. SIOs shall be mounted (1) where existing boxes are in place, (2) on surface mount raceway typically in surface raceway with barrier, (3) on floor mount interface boxes, or (4) on power poles either currently owned or new.
3. The telecommunications outlet frame shall accommodate or incorporate the following:
   a. A minimum of four (4) modular jacks, when installed on a wall-mounted assembly.
   b. A maximum of 6 cables shall be in a single outlet box/faceplate. If more than 6 cable/jacks are needed at one location, contractor shall provide adjustment faceplates with not more than 6 jacks per faceplate.
   c. A mechanism for adjusting the surface plate to a plumb position.
4. Multiple jacks are identified in close proximity on the Drawings. The Contractor shall determine the optimum compliant configuration based on the products proposed.
5. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each SIO type for review by the Consultant.

B. Modular Jack
1. Data jacks shall be non-keyed 8-pin modular jacks.
2. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
3. Jacks shall utilize a four-layer printed circuit board to control NEXT.
4. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
5. Modular jack contacts shall accept 2500 plug insertions.
6. Modular jack contacts shall be formed flat for increased surface contact with mated plugs. These contacts shall be arranged on the PC board in two staggered arrays of four to maximize contact spacing and minimize crosstalk.

7. Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
8. Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
9. Jack termination shall be110 IDC, integral to the jack housing, laid out in two arrays of four contacts.
10. Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
11. Jacks shall utilize tin lead plated (60% tin/40%lead) phosphor bronze 110 insulation displacement contacts.
12. Jacks shall terminate 22-26 AWG stranded or solid conductors.
13. Jacks shall terminate insulated conductors with outside diameters up to .050".
14. Jacks shall be compatible with single conductor 110 impact termination tools.
15. Jacks shall be compatible with EIA/TIA 606 color code labeling and accept snap on icons for identification or designation of applications.
16. Jacks shall be Gray in color.
17. Jacks shall be marked as either T568A or T568B wiring.
18. Category 6 jacks shall be manufactured by Leviton 61110-RG6.
19. Category 6a jacks shall be manufactured by Leviton 6AUJK-RG6

C. Outlet Faceplates

1. Faceplates shall be stainless steel and incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
2. Any unused jack positions shall be fitted with a removable blank inserted into the opening.
3. Modular jacks shall have capability to incorporate a dust cover that fits over and/or into the jack opening. The dust cover shall be designed to remain with the jack assembly when the jack is in use. No damage to the jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the jack pinning shall not be accepted.
4. Wall-mounted "voice only" outlets shall be installed where identified on the floor plan Drawings to accommodate wall-mounted telephone sets. The wall plate shall be of stainless steel construction, accommodate one (1) voice jack as defined below, mount on a standard single gang outlet box or bracket, and include mating lugs for wall phone mounting.
5. All standard information outlets and the associated jacks shall be of the same manufacturer throughout each/the building. An allowable exception, however, is the wall-mounted "voice only" outlet described above.
6. Faceplates shall be manufactured by modular jack manufacturer.

D. Surface Mount Interface Box

E. Low profile, surface mount boxes shall incorporate recessed designation strips at the top for identifying labels. Designation strips shall be fitted with clear plastic covers.

F. The box shall feature built-in cable management for both fiber and copper applications.

G. Any unused jack positions shall be fitted with a removable blank inserted into the opening.

H. Modular jacks shall have capability to incorporate spring-loaded shutter door for added protection from dust and other airborne contaminants. The dust cover shall be designed to remain with the jack assembly when the jack is in use.

I. The box shall have the capability to incorporate optional magnets that can be internally mounted.

J. Surface mount box shall be manufactured by modular jack manufacturer.

2.6 Additional Modules for Copper Cabling

A. Additional modules for copper shall include the following:
1. 50 and 75 Ohm BNC coax coupler modules, male-male
2. F-type coax coupler module, male-male threaded
3. RCA connector modules with black, red, yellow, and white inserts
4. Solder, pass-through and punch-down termination types
5. S-Video connectors modules - coupler and punch-down termination types
6. Blank module to reserve space for future additions

B. The connectors shall be designed to allow snap-in installation into the outlet faceplates.

2.7 Cable Hook Systems

A. In the areas where the cables are required to be run in a “free-air” plenum, a cable hook system shall be used.

B. Cable hooks shall be capable of supporting a minimum of 30 lbs with a safety factor of 3.

C. Spring steel cable hooks shall be capable of supporting a minimum of 100 lbs with a safety factor of 3 where extra strength is required.

D. Follow manufacturer’s recommendations for allowable fill capacity for each size of cable hook.

E. Installation and configuration shall conform to the requirements of the ANSI/ EIA/TIA Standards 568A & 569, NFPA 70 (National Electrical Code), and applicable local codes.

F. Cable hooks shall:
1. Have a flat bottom and provide a minimum of 1 5/8" cable bearing surface.
2. Have 90-degree radiused edges to prevent damage while installing cables.
3. Be designed so the mounting hardware is recessed to prevent cable damage.
4. Have a retainer that shall be removable and reusable.

5. Be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, and floor posts, to meet job conditions.
6. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

G. Cable hooks shall be:

H. B-Line series BCH21, BCH32

I. Cable trunks with less than 20 cables may be supported by Stiffy (Tomarco/CEAS Attachment Products).

PART 3 - Execution

3.1 Twisted Pair Test Equipment

A. Test equipment used under this contract shall be from a manufacturer who has a minimum of five years' experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

B. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output. Test adapter cable shall be approved by the manufacturer of the test equipment. Baseline accuracy of the test equipment shall exceed TIA Level III, as indicated by independent laboratory testing.

C. Test equipment shall:
1. Be capable of certifying Category 5E, 6 and 6A permanent links.
2. Have a dynamic range of at least 100dB to minimized measurement uncertainty.
3. Be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
4. Include S-band time domain diagnostics for NEXT and return loss.
5. Be capable of running individual NEXT, return loss, etc., measurements in addition to AutoText.
6. Include a library of cable types, stored by major manufacturer.
7. Store at least 1000 Category 5e, 6 or 6A autotests in internal memory.

D. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurements.

E. The approved manufacturer of the test equipment is Fluke.

3.2 Cable Support

A. J-hooks fabricated to contain data/voice and video cables may be used to support 25 or fewer cables in each hook. J-hooks are to be fastened to building steel with beam clamps, suspended from ceiling slab with threaded rod, or anchored to the wall. All J-hooks shall be hung straight and level. No other installation technique will be authorized unless pre-approved.

B. Three tiered double-sided J-hook configurations shall contain a maximum of 25 cables per hook or 150 cables. Smaller configurations may be used as bundles decrease in size, maintaining no more than 25 cables per hook.

C. Bundles surpassing 150 cables shall be supported by hangers, fabricated of 3/8" threaded rod and 24" Unistrut. Hangers shall also be installed where the installation of a three-tiered J-hook system is not appropriate for the ceiling space, or where blocked by other trades' work.

D. Cable bundles consisting of fewer than 20 cables may be supported by single J hooks or Stiffy (Tomarco/CEAS Attachment Products)

E. All cable support in the cable path shall be installed every four and five feet (staggered).

F. A sag shall be maintained between supports of 6", to reduce cable strain. Velcro is an appropriate method of securing cables, when properly used and not over tightened.

G. Proper cable support is extremely important to the Owner, and care shall be taken by the Contractor to provide and install the appropriate supports. Supports found to be inadequate will be replaced.

H. Cable bundles including voice/data cabling shall not have plastic cable ties.

I. All cable trunks shall have radius controlled cable waterfalls where trunk drops from conduit, sleeve or tray from horizontal path to vertical path.

3.3 Station Cabling

A. Information outlet cables with copper media (voice & data UTP and "TV" coax) shall be located as detailed on the Project Drawings.

B. The Contractor shall utilize these documents in determining materials quantities and routing.

C. Station cables shall be run to the information outlet from the MER/TR serving each area in conduit, free-air above drop ceiling, in cable tray, and/or in modular furniture.

D. The maximum station cable drop length for UTP cables shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the

termination panel in the wiring closet to the outlet and shall include any slack required for the installation and termination. The Contractor shall install station cabling in a fashion to avoid unnecessarily long runs.

E. Contractor shall verify cable lengths comply with published standards; prior to installation of any horizontal cabling, this Contractor shall verify cable paths and confirm no horizontal cable will exceed 295 total feet. If it is determined that the cable will exceed 295', this Contractor shall route the cabling to another MER/TR or determine shorter path so cables are under 295'. If this is not possible, the Contractor shall notify the Consultant prior to installation. Failure to do this step will not result in a change order from the Contractor.

F. The minimum station cable drop length for UTP cables shall be no less than 45 feet. The Contractor shall install station cabling in a fashion to avoid runs less than 45 feet. If cable slack is required to accommodate the minimum length requirements, the Contractor is responsible for storing the slack in a fashion as to protect the cable from damage. The cable slack shall be secure above the ceiling tiles in a figure 8 form by means of J-hooks or D-rings anchored to the building structure. The cable slack shall be coiled to maintain from 100% to 200% of the cable recommended minimum bend radius. Multiple cables may share a common support.

G. All cables shall be installed splice-free unless otherwise specified.

H. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.

I. Avoid abrasion and other damage to cables during installation.

J. All cable shall be free of tension at both ends. In cases where the cable shall bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

K. Where installed free-air, installation shall consider the following:
1. Cable shall run at right angles and be kept clear of other trades' work.
2. Cables shall be supported according to code, using "J-hooks" anchored to ceiling concrete, walls, piping supports, or structural steel beams.
3. Hooks shall be designed to maintain cable bend to larger than the minimum bend radius (typically 4 x cable diameter).
4. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 6 inches, another support shall be used.

L. Cable shall never be laid directly on the ceiling grid.

M. Cables shall not be attached to existing cabling, plumbing, or steam piping, ductwork, ceiling supports, or electrical or communications conduit.

N. Manufacturers minimum bend radius specifications shall be observed in all instances. Use of plastic cable ties is not acceptable. Cable bundles shall be neatly dressed with use of Velcro type straps.

O. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

P. A coil of one foot in each cable shall be placed in the ceiling at the last support (e.g., J-hook) before the cables enter a fishable wall, conduit, surface raceway, or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15 feet of slack shall be left in each station cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

Q. To reduce or eliminate EMI, the following minimum separation distances from
1. 480V power lines shall be adhered to:
2. Twelve (12) inches from power lines of 5-kVa
3. Eighteen (18) inches from high voltage lighting (including fluorescent)
4. Thirty-nine (39) inches from power lines of 5-kVa or greater
5. Thirty-nine (39) inches from transformers and motors

R. All openings shall be sleeved and firestopped per prevailing code requirements upon completion of cable installation.

3.4 Information Outlet

A. Information outlets shall be flush mounted on wall-mounted boxes, in floor- mounted boxes, on surface raceway, or on modular furniture.

B. Any outlets to be added where these conditions are not met shall be positioned at a height matching that of existing services or as directed otherwise by the Site Coordinator and the Consultant. Nominal height (from finished floor to center line of outlet) in new installation shall be as follows:
1. Standard Voice & Data Outlet (SIO) shall match adjacent electrical outlets.
2. Wall-Mounted Telephone Outlet (Standard Voice only) shall meet ADA requirements.
3. The Contractor shall coordinate the style of the telecommunication outlets to be installed in the floor mount boxes and surface mount raceways with the Owner.

3.5 Cable Termination

A. At the telecommunication closet, all data and voice cables shall be positioned on termination hardware in sequence of the outlet ID, starting with the lowest number.

B. Termination hardware (blocks and patch panels) positioning and layout will be reviewed and approved by the Consultant prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.

C. Cable Termination – Data/Voice UTP

1. Data/voice patch panels shall be designed and installed in a fashion as to allow future station cabling to be terminated on the panel without disruption to existing connections.
2. Data patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.
3. At information outlets and data/voice patch panels, the installer shall ensure that the twists in each cable pair are preserved to within 0.5 inch of the termination for data/voice cables. The cable jacket shall be removed only to the extent required to make the termination.

D. Cable Termination – Fiber Optic

E. All fibers shall be terminated using the specified connector type.

1. All terminated fibers at the telecommunications closets shall be mated to couplings mounted on patch panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.
2. All couplings shall be fitted with a dust cap.
3. Fibers from multiple locations may share a common enclosure, but they shall be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure, provided they are clearly identified as such. Fibers from different locations shall not share a common connector panel (e.g., “insert”).
4. Slack in each fiber shall be provided as to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30” high workbench positioned adjacent to the termination enclosure(s). A minimum of one meter (~39”) of slack shall be retained regardless of panel position relative to the potential work area.
5. Contractor shall install a plastic twist-on bushing on each end of interlocking armored fiber to protect cable from sharp edges of the armor.

3.6 Test Data – Copper Media

A. The test result records saved by the tester shall be transferred into a Windows- based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test. Comma separated value (CSV) format is not acceptable.

B. The database for the completed job – including twisted-pair copper cabling links, if applicable – shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

C. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
   1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
   2. The overall Pass/Fail evaluation of the copper channel-under-test, including the NEXT worst-case margin (margin is defined as the difference between the measured value and the test limit value).
   3. The overall Pass/Fail evaluation of the fiber link-under-test, including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value).
   4. The date and time the test results were saved in the memory of the tester.

3.7 Copper Station Cables

A. Station cabling testing shall be from the jack at the outlet in the work area to the termination block on which the cables are terminated at the MDF or IDF.

B. Testing shall be of the permanent link. Contractor shall warrant performance, however, based on channel performance and provide patch cords that meet channel performance criteria. All cabling not tested strictly in accordance with these procedures shall be retested at no cost to the Owner.

C. Testing shall be from the jack at the SIO to the patch panel on which the cables are terminated at the wiring hub.

D. Horizontal “station” cables shall be free of shorts within the pairs and shall be verified for continuity, pair validity and polarity, and wire map (conductor position on the modular jack). Any defective, split, or mispositioned pairs shall be identified and corrected.

E. Testing of the cabling systems rated at TIA Category 6/6a and above shall be performed to confirm proper functioning and performance.

F. Testing of the transmission performance of station cables (Category 6/6a) shall include the following:
   1. Length
   2. Attenuation
   3. Pair to Pair NEXT
   4. ACR
   5. PSNEXT Loss
   6. Return Loss
   7. Pair to Pair ELFEXT Loss or ACRF
   8. PSEFEXT Loss or PS-ACRF
   9. Propagation Delay
   10. Delay Skew
   11. Return Loss

G. The maximum length of station cable shall not exceed 90 meters, which allows 10 meters for equipment and patch cables.

H. Worst case performance at 20°C, based on a horizontal cable length of 90 meters and equipment cord length of 4 meters, shall be as follows:

1. CATEGORY 6 (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ELFEXT Loss Pair to Pair (dB)	PSELFEXT loss (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3
62.5	14.1	45.1	42.7	28.3	25.3
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2

2. CATEGORY 6A (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ACRF Pair to Pair (dB)	PS-ACRF (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3
62.5	14.1	45.1	42.7	28.3	25.3
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2
300.0	32.7	34.0	31.4	14.6	11.6
400.0	38.5	29.9	27.1	12.1	9.1
500.0	43.8	26.7	23.8	10.2	7.2

I. In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty

or defective material, equipment, or installation method. The Contractor shall make additional tests as the Consultant deems necessary at no additional expense to the Owner or Consultant.

J. All data shall indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combination and in both directions when required by the appropriate standards.

K. Cables shall be tested to the maximum frequency defined by the standards covering that performance category. Transmission Performance Testing shall be performed using a test instrument designed for testing to the specified frequencies. Test records shall verify “PASS” on each cable and display the specified parameters— comparing test values with standards-based “templates” integral to the unit.

END OF SECTION 27 15 00

SECTION 27 16 00 – COMMUNICATIONS CONNECTING CORDS

PART 1 - General

1.1 Scope

A. This section describes the products relating to high quality Category 6 voice and data patch cords.

B. In this section the term patch cords refer to the cords that connect Owner provided data network electronics to the horizontal cable infrastructure.

C. It is important that the horizontal cable system and the provided patch cords work as one complete system for guaranteed channel performance. Patch cords shall be manufactured by the same manufacturer as the jack and patch panels.

D. The Contractor shall provide and deliver all cords as listed in this section. The Owner will be responsible for installation of cords.

1.2 Related Work

A. General Technology Requirements

B. Pathways for Technology Systems

C. Communications Cabling General Requirements

D. Grounding and Bonding for Technology Systems

E. Communications Equipment Rooms

F. Communications Backbone Cabling

G. Communications Horizontal Cabling

H. Communications Labeling and Identification

PART 2 - Products

A. Substitutions

B. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.2 Category 6/6A Patch Cords

A. The Owner has the right to determine the final length of the patch cords after the contract is awarded.

B. All Category 6/6A UTP patch cords shall be round and consist of eight insulated 23 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame retardant jacket and be backwards compatible with lower performing categories. Modular patch cords shall utilize ISO termination method that is designed to reduce and control near-end cross talk (NEXT) and far end cross talk (FEXT) without compromising signal impedance.

C. Both ends of the cord shall be equipped with modular 8-position (RJ45 style) plugs wired straight through with standards compliant wiring. All modular plugs shall exceed FCC CFR 47 part 68 subpart F and IEC 603.7 specifications, and have 50 micro inches of gold plating over nickel contacts. Cable shall be label-verifiable. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Category 6/6A cords shall have color-coded insert molded strain relief boot with a latch guard to protect against snagging. Additional color- coding shall be available by the use of snap-in icons.

D. Patch cords shall be wired straight through. Pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring per ANSI/TIA/EIA- 568-B. Patch cords shall be unkeyed.

E. The manufacturer of the cords shall be the same as the manufacturer for UTP termination hardware (jacks & patch panels). Cords shall be highest quality Category 6/6A cords available by connectivity manufacturer.

1. Blue – Cat 6 [Standard data/phone]
   a. 33% 7-foot
   b. 33% 10-foot
   c. 33% 14-foot
2. Green – Cat 6 [Standard data/phone]
   a. 33% 7-foot
   b. 33% 10-foot
   c. 33% 14-foot
3. Yellow - Cat 6A [Wireless APs)
   a. Two (2) 7-foot for each WAPs
4. Red – Cat 6 [Fire Alarm or Security Equipment]
   a. Two (2) 10-foot for each installed cable.
5. Orange – Cat 6A [Copper Backbone Uplinks]
   a. Four (4) 7-foot for each IDF
6. Cords shall be Leviton 6D460-xxx

F. For outlets, furnish to the owner at the time of final inspection (1) Category 6 modular non-booted patch cord for each terminated horizontal data cable plus 25 percent, 50 percent of the total quantity shall be blue and the other 50 percent shall be green in the following proportions:

1. Blue – Cat 6 [Standard data/phone]
   a. 50% 10-foot
   b. 50% 14-foot
2. Black
   a. 50% 10-foot
   b. 50% 14-foot

PART 3 - Execution

3.1 Ordering and Delivery

A. Prior to ordering patch cords the Contractor shall schedule meeting with Owner to verify patch cord lengths, colors and quantities.

B. Contractor shall coordinate delivery of patch cords with Owner. Contractor shall have list of delivered cords and shall have Owner sign delivery sheet at time of delivery.

END OF SECTION 27 16 00

SECTION 27 18 00 – COMMUNICATIONS LABELING AND IDENTIFICATION

PART 1 - General

1.1 Scope

A. This section describes the products and execution requirements relating to labeling of telecommunications cabling, termination components, and related subsystems. Covered systems include the following:
   1. Equipment room backboards and equipment racks
   2. Station cable and terminating equipment
   3. Telecommunications grounds and related components

1.2 Related Work

A. General Technology Requirements

B. Pathways for Technology Systems

C. Communications Cabling General Requirements

D. Grounding and Bonding for Technology Systems

E. Communications Equipment Rooms

F. Communications Backbone Cabling

G. Communications Horizontal Cabling

H. Communications Connecting Cords

PART 2 - Products

2.1 Substitutions

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.2 Labels

A. All labels shall be permanent and be machine generated (e.g., Brady or Panduit). No handwritten or non-permanent labels shall be allowed. Labels shall be Brady "I.D. Pro" or XC-Plus or equivalent. Labeling on backboards and/or equipment racks may be pre-cut adhesive type.

B. Characters on all labels shall be black printed on a white background.

C. Label size shall be appropriate to the cable size(s), outlet faceplate layout, patch panel design, or other related equipment sizes and layouts.

D. All labels to be used on cables shall be self-laminating, white/transparent vinyl, and be wrapped around the cable sheath. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self- laminated over the full extent of the printed area of the label.

E. Labels used to identify innerduct carrying fiber optic cable shall be labeled with a durable yellow polyethylene tag that reads "CAUTION Fiber Optic Cable" and includes blank spaces for adding (1) fiber count and (2) destination information. An example of a compliant product is VIP Products' "Caution Write-On Coverall Tag."

PART 3 - Execution

3.1 General

A. Clean surfaces before attaching labels.

B. Install all labels firmly. Labels attached to terminating equipment such as backboards, faceplates, 110 blocks, and patch panels shall be installed plumb and neatly on all equipment.

3.2 Labeling of Cabling and Termination Components

A. Backboard and Equipment Racks
   1. Backboards and equipment racks shall be labeled by the Contractor identifying the telecommunication room. Additionally, equipment racks shall have an alpha character after the room number unique to that particular communications closet. For example, TR1-A would be the first rack in TR1.
   2. Character height shall be 1-inch (minimum).

B. Cabling

1. Horizontal cables shall have a machine generated wrap around cable label within 4” of each end of the cable. Label shall be clearly legible and meet TIA- EIA 606 standards. Character height shall be .25” (minimum).
2. Voice/data/video backbone cables shall have a machine generated wrap around cable label within 12” of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standard. Character height shall be .5” (minimum).

3.3 Fiber Optic Backbone, Riser Cables, and Termination Components

A. All fiber optic backbone and copper (inter-building, riser, and tie) cables shall be identified AT BOTH ENDS with a designation that identifies where the opposite end of the same cable terminates (e.g., equipment room or telecommunications room I.D.). In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.

B. Each fiber optic termination panel shall be clearly labeled indicating the destination of the cable(s) and the fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

3.4 Standard Information Outlet (SIO) Faceplates

A. All faceplates shall be clearly labeled indicating the destination of the cable(s) (telecommunication room number), the data patch panel(s) letter designation, the data port number(s) on the data patch panel(s), and the voice cable number(s).

B. Telecommunications outlets are to be labeled (1) on the cover of the assembly and

C. (2) on each cable terminated at that location.

D. Station cables shall be labeled within two inches of the cable end.

3.5 Data Patch Panels

A. All data patch panels shall be clearly labeled indicating the telecommunication room number, the data patch panel letter designation, and the data port number on the data patch panel (ports 1 through 48). Each telecommunication room shall start with data patch panel ‘A’ and continue through the alphabet.

B. A data port schedule for each telecommunication room shall be created in spreadsheet format (Excel) with the telecommunication room number, data patch panel letter designations, data port numbers, and room numbers identified in the spreadsheet. In addition, for each data patch panel port, a field shall be provided in the spreadsheet for the Owner to manage the cabling

infrastructure by recording the device and any special notes pertaining to the room utilizing the data cable terminated to the port.

C. Refer to Telecommunication "T" Series Project Drawings for standard information outlet faceplate and data & voice patch panel labeling scheme requirements. A sample of the data and voice port schedules is to be provided to the Owner, in the cable record book and in electronic format (Excel spreadsheet), with final documents provided on the Project Drawings.

3.6 Fiber Optic Cables and Termination Components

A. All fiber optic cables, termination enclosures and connector panels, and splice closures shall be clearly labeled.

B. In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.

C. Each fiber optic termination panel shall be clearly labeled indicating (1) the destination(s) of the cable(s) and (2) fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

3.7 Ground System Labeling

A. All grounds shall be labeled as close as practical to the point of termination (for ease of access to read the label). Labels shall be nonmetallic and include the following statement: "WARNING: If this connector or cable is loose or must be removed, please call the building telecommunications manger." Refer to ANSI/TIA/EIA 606 for additional labeling requirements.

END OF SECTION 27 18 00

Division 28 –Access Control and Fire Alarm Systems

28 13 00 Access Control
28 31 11 Digital, Addressable Fire-Alarm System

Division 28 – Access Control Systems

SECTION 28 13 00 – ACCESS CONTROL

PART 1 - General

1.1 Summary

A. The work covered by this Section shall include all labor, equipment, materials, ancillary materials and services to furnish, install, test, and turnover components establishing a complete and operational microprocessor-based Access Control System (ACS), as described herein and in the contract drawings. This section includes specifications for an electronic access control system, which shall perform the following general services:
   1. Access Control
   2. Photo Badge Production
   3. Digital Video Recording
   4. Alarm Monitoring
   5. Visitor Management
   6. Alarm Graphics

B. Related Sections include the following
   1. Division 08 for any door hardware items that interface with electronic safety and security systems.

1.2 Price and Payment Procedures

A. Alternates: Alternate pricing shall be provided as a separate attachment and shall conform to guidelines set in section 1.3

1.3 Value Analysis

A. Any value analysis shall provide as an addition or deduct to this specification proposal. All value analysis items shall provide the following:
   1. Value proposition
   2. Action submittals as outlined in part 1.6
   3. Add / deduct pricing

1.4 References

A. Abbreviations and Acronyms
   1. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
   2. UPS: Uninterruptible power supply.

3. WAN: Wide area network.
4. RF: Radio frequency.
5. I/O: Input/Output.
6. LAN: Local area network.
7. LED: Light-emitting diode.
8. CPU: Central processing unit.
9. ACS: Access control system.
10. CCTV: Closed-circuit television.

B. Definitions

1. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
2. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
3. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
4. Credential: Data assigned to an entity and used to identify that entity.
5. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
6. File Server: A PC in a network that stores the programs and data files shared by users.
7. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
8. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
9. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
10. ROM: Read-only memory. ROM data is maintained through losses of power.
11. RS-232: A TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
12. RS-485: A TIA/EIA standard for multipoint communications.
13. WAV: The digital audio format used in Microsoft Windows.
14. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
15. Workstation: A PC with software that is configured for specific limited security system functions.

C. Reference Standards

1. FCC: All assemblies shall be in compliance with FCC emission standards.

a. Microprocessor based controller: Part 15, Subpart F, Class A.
b. Proximity Card Reading Sensors: Part 15, Subpart F (field disturbance sensors).
c. Dial-up modems: Part 68

2. International Fire Code
3. American National Standards Institute (ANSI)
4. NFPA 70 National Electric Code International Organization for Standardization (ISO)
5. NEMA: Electrical equipment shall comply with applicable portions of NEMA.
6. Underwriters Laboratories (UL)
   a. UL-1012 and CSA: All power supplies shall be in compliance with Underwriters Laboratories standard 1012 and CSA standards for power supplies.
   b. UL-294: The system shall comply with Underwriter Laboratories standard 294 for Access Control Systems.
7. All applicable state and local codes

1.5 Administrative Requirements

A. Coordination: The ACS contractor is required to coordinate with all required trades work that is required by and for "others".

B. Pre-installation Meetings: Pre-installation meetings shall be held outlining requirements of all trades involved in the successful installation of this ACS.

C. Sequencing: The work shall be performed in the following sequence:
1. Installation of Access Controllers & Modules.
2. Installation of new devices and new readers.
3. Installation of site control equipment.
4. Commissioning of the new system components.

D. Scheduling: The ACS contractor shall schedule work in order to complete the ACS in accordance with the project timeline.

1.6 Action Submittals

A. Submit evidence of compliance for Security Contractor and equipment manufacturer prior to Bid, and as indicated under the quality assurance section(s) of Division 28 Specification Sections and this section.
1. Submit a list of a minimum of 3 facilities within the United States of equal size and technical requirements utilizing the equipment submitted. For each facility, list:
   a. Name and location of facility.
   b. Date of Occupancy by Owner.
   c. Owner's representative to contact and telephone number.
   d. Construction Manager or General Contractor.
   e. Architect.

f. Provide information on the installed locations with operational equipment.

B. Submit data consisting of shop drawings and catalog cuts complete with technical data necessary to evaluate the material and equipment. Include dimension, wiring and block diagrams, performance data, ratings, control sequences, and other descriptive data necessary to describe the item proposed and its operating characteristics. Include compete technical specification for the submitted equipment, noting differences and adherence to all Division 28 Sections.

C. Submit shop drawings and product data in accordance with Division 1 and this Section.
1. Coordinate with other trades in submittal of shop drawings.
2. Shop drawings shall detail space conditions and shall be subject to final review by the Architect.
3. Submit full size drawings depicting the security monitoring screen floor and site plan layout for each arrangement of associated indicator and control icons.
4. Submit a full size set of color drawings depicting the graphic floor plan and site plan layout for each screen and graphic panel with arrangement of associated lights, icons and switches/pushbuttons.
5. Provide an operational narrative of each component/system.
6. Submit to Owner a complete listing of proposed devices, indicating interconnection equipment locations and specifying terminal/connecter termination locations. Submit a complete set of proposed drawings, identifying equipment locations, types of cabling, numbers of conductors, raceway locations, and termination points of each conductor.
7. The approval of shop drawings or samples does not relieve the Security Contractor of responsibility for any deviation from the requirements of the Contract Documents, unless the Security Contractor has informed the Architect in writing of such deviation at the time of submission, has noted the deviation on the shop drawings, and the Architect has given written approval of the specific deviation. The Architect's approval also does not relieve the Security Contractor from responsibility for errors or omissions in the shop drawings or samples.
8. Coordinate equipment submittals with construction schedules.
9. Do not purchase or install equipment requiring submittal until the review process is complete.

1.7 Information Submittals

A. Coordinate with, and submit for Owner approval a listing of all system components with recommended labeling for identification within the system.

B. Coordinate with, and Submit for Owner approval a listing of doors recommended for time zone unlocking/alarm shunting.

C. Coordinate with, and Submit for Owner approval a listing of operator privileges recommended for system segregation.

D. Project Record Documents:
   1. As-Built Drawings: Security Contractor shall maintain record "as-built" drawings. Upon Security Contractor completion of the final punch list, a full size set of drawings and one set of CAD disks shall be submitted for review and record.
   2. The Security Contractor shall provide documentation of all final components showing the following information.
      a. System Label
      b. Physical Location
      c. System address
      d. Functional description

1.8 Closeout Submittals

A. Warranty Documentation: Provide copies of manufacturers warranties for all system components and applicable equipment. Include statement of labor warranty from the manufacturer, Security Contractor, and/or 3rd party entity.

B. Extra Stock Materials: Furnish materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

C. Substantial Design Closeout Documentation
   1. Operation and Maintenance Manual Data: Submit data in accordance with Division 1 and this Section for all equipment specified in this Section. Include complete set of supplier's operating instructions, installation instructions, and troubleshooting guide. Include final listing of doors, locations and normal status.
   2. Prior to Substantial Completion, provide schematic drawings depicting type and location of interface equipment/components, number of cables and conductors, raceway locations, types of connectors, circuit requirements and type and dimensions of enclosures.

D. Tools
   1. The Security Contractor shall provide documentation of any specialized tools required by the End User in order to perform routine maintenance.

E. Commissioning Reports: Security Contractor shall provide documentation of both the Final Test Acceptance and Start up Testing as per Part 3, 3.12.

1.9 Quality Assurance

A. Qualifications
   1. Manufacturer:

a. Manufacturer of products defined in this section shall have at least 10 years experience in manufacturing and servicing access control and management systems.
b. Manufacturing process of company shall meet standards of ISO 9001 Certification.

2. Supplier:
   a. Obtain Central Station, workstations, Controllers, Identifier readers, and all software through one source from a single manufacturer.
3. Installer / Systems Integrator Qualifications:
   a. An employer of workers trained and approved by manufacturer.
   b. Company with a minimum of 5 (five) years system design, engineering supervision, and installation experience in the alarm or access control industry.
   c. Company that is trained, authorized, and certified to install the specified products.
   d. Company has local coverage for all sites included in this section qualified to service the products being installed.
   e. Service facility: Systems Integrator shall have service facilities within 50 miles of the installation.
4. Testing Agency
   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.

1.10 Delivery, Storage, and Handling

A. Acceptance: Upon delivery to the site, Contractor shall inspect all products and materials for any damage. Acceptance of the units constitutes that the inspection has occurred and no damaged or unacceptable products were found, and any damage or unacceptable products would be the responsibility of the Contractor.

B. Product Storage and Handling Requirements
1. Central Station, Workstations, and Controllers:
   a. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, non-condensing.
   b. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
   c. Mark packing list with designations that have been assigned to materials and equipment for recording in the system labeling schedules that are generated by cable and asset management system specified in Part 2.
   d. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.11 Site Conditions

A. Ambient Environmental Requirements: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, non-condensing.
2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
3. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 12 enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h). NEMA 250, Type 4 or 4X enclosures.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X or 6P enclosures.
7. Begin installation of electronic components only when the following is met, in each installation area:
    a. All wet work is completed.
    b. Area is dust free.
    c. Painting work is completed.

1.12 Warranty

A. Special Warranty

1. Proximity Access Cards and Readers: Proximity card and readers shall provide a lifetime warranty against workmanship and defects.
2. System Components: One (1) year from date of Substantial Completion.
3. Labor: One (1) year from date of Substantial Completion.

B. Extended Correction Period: On system components that require an extended correction period after Substantial Completion, the above Warranty shall commence at the end of the extended correction period.

PART 2 - Products

2.1 Manufacturers & Integrators

A. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   1. Access Control System Hardware/Firmware/Software:
      a. *Genetec Version 5.11 or latest version.*
      b. *Legacy:* Security Management System (Vanderbilt Version 6.3)
      c. No Substitutions
   2. Power Supplies:
      a. Schlage Electronic Security and/or Vanderbilt
      b. No Substitutions
   3. Credentials & Readers:
      a. Schlage Electronic Security
      b. No Substitutions
   4. Remote Key Switches & Request-to-Exit Buttons:
      a. Schlage Electronic Security
      b. Approved Equal
   5. Door Position Switches/Contacts:
      a. Schlage Electronic Security
      b. Approved Equal
   6. Request-to-Exit Motion Sensors:
      a. Schlage Electronic Security
      b. Approved Equal
   7. Electric Horns, Door Alarms, Strobes:
      a. Schlage Electronic Security
      b. Approved Equal
   8. Acceptable Integrators are as follows:
      a. Texas Lock & Door Closer, San Antonio, Texas (Mr. Mike Skinner)
      b. 3Sixty Integrated, San Antonio, Texas (Mr. David Cruz)

2.2 Access Control System Requirements

A. General Access Control System Description:
   1. The Access Control System's primary function is to regulate access through specific portals to secured areas and provide security functions noted in this Section.
   2. The ACS shall utilize proximity card technology as its primary access device but will support other input technologies at each door.
   3. Surge and Tamper Protection:
      a. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or

sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

b. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

B. General Access Control Hardware Description:

1. The ACS Hardware shall be expandable to meet all criteria noted in Section 2.4 of this document.
2. The ACS Hardware shall include all options to accommodate all devices in the construction documents.
3. The ACS Hardware shall include devices to accommodate the following functions:
   a. The system shall include hard wired locking hardware programmable by the ACS system. All hard wired hardware shall provide support for a minimum of 1000 users and 1000 audit events. Hard wired hardware shall be hard powered utilizing local stand alone controllers.
   b. The ACS shall be able to support proximity credential technology at every access control location.
   c. The ACS contractor shall provide 300 proximity credentials.

C. Internal System Security Provisions:

1. Supervised Wiring: Selected field wiring shall be supervised. Cutting, shorting, or altering connections of any wire listed as supervised below, shall be detected, and activate an alarm condition at system workstations. Provide wiring supervision for the following functions:
   a. Tamper Switches.
   b. Door Position or Contact Switches.
   c. Panic/Duress Alarms.
   d. Other intrusion detection/alarm input devices, as defined herein and indicated on the Drawings.
2. Provide signs or labels for all tamper monitored enclosures warning that an alarm will sound if access is attempted, and giving the telephone number of the security workstation operator.
3. Access Control System head end shall be interfaced with the CCTV system head end to cause automatic call up (via ASCII text string). Upon alarm or selected event condition, the access control system shall cause the CCTV system to automatically call up the camera image associated with the alarm or event point or location.
4. Interface with the Fire Alarm System: The ACS shall be programmed so that relay output contact(s) from the fire control panel will be capable of initiating a selected or zoned unlocking of secured portals during potential emergency incidents or situations. Coordinate the requirements of this physical interface with other disciplines affecting the Work.

D. Ensure integration with, and control of, motorized doors, gates and turnstiles included in the project.

E. When the access control system is used to activate or open doors equipped with motorized operators and electric locks, provide a 0.5 second delay timer to delay activation of the door operator until the electric locks are released.

F. Multiple Contractor User privilege levels established during the installation and testing periods of this Project shall be removed from the system, unless otherwise authorized in writing by the Owner.

2.3 Materials, General

A. Power: All ACS equipment shall operate on 120-VAC. Any special power treatment required, such as filtering or spike elimination that may be required for proper operation and protection of the ACS, shall be provided with the system.

B. Backup Power: ACS equipment shall be supplied from a UPS system, which shall be tied to emergency building power circuits. The UPS shall power the equipment including, but not limited to, access control processors, modules, electronic locks and lock power supplies for a minimum of 4 hours. Access control system PC Servers and Workstations shall be equipped with a local Uninterruptible Power Supply (UPS). The UPS shall provide a minimum of 600VA.

C. Hardware: Provide a distributed access control system as required for a complete operating system as described herein and as shown on the Drawings.

2.4 Access Control System Hardware / Firmware

A. All the hardware shall be provided with enclosures, which have hinged doors and latches. All the enclosures shall be equipped with tamper switches.

B. Control Panels

1. The control panels shall be independently programmed, intelligent devices, which shall be able to make decisions at the local level. The system shall provide reader controllers at 2, 8 and 16-reader capacity.
2. The system shall also provide alarm control boards, which has 24 supervised contacts and 24SPDT relays. It shall be connected to reader controllers with 8 or 16-reader capacity. These boards shall be utilized for alarm control as well as elevator control.
3. The system shall support direct and master/slave configurations. Reader Interfaces and controllers may be connected to the same board but they may not be mixed in the same channel.
4. The system shall also support small controller boards, which is ideal for small systems. These boards shall act as master controllers, which shall be able to support a maximum of sixteen (16), control panels with 2-reader capacity. These controllers shall support any kind of read head technologies and keypads.

5. The communication between the PC and the control panel shall be directly through a serial port or through an IP addressable modem. The system shall also support dial up connection.
6. The control panel shall also dial the PC automatically when the alarm or the transaction buffer is 75% full.
7. The communication between PC and the control panel shall be via RS232 protocol on a direct connection.
8. The communication between control panel and the reader interface shall be via RS485 protocol.
9. The control panels shall be used with any combination of read head technologies: magnetic stripe, wiegand, barium ferrite, bar code, smart card, biometric and more.
10. The panel shall provide monitoring of up to 16 supervised or unsupervised contact inputs and two fourteen (14), 3-amp relay outputs, in addition to monitoring AC power and low battery. To support this functionality, an expansion board shall be required.
11. The control panels shall be filtered at the operator level. The filter shall allow operating, editing, viewing or denying access to the hardware.
12. All the commands and updates to the panels shall be verified and shall automatically retry if communication have failed.
13. Provide a system scheduler that shall automatically call remote locations to update panel information and get transactions.
14. Each panel shall be addressed within the system by a unique user defined name.
15. The control panel shall incorporate an on-board 16-channel multiplexer to support up to 16 readers. In cases where the physical environment dictates running a single pair of wire, the panel shall provide a point on the board capable of supporting up to 16 card readers in a multiplex or multi-drop configuration. Hardwire connection shall be 2-Wire RS485. Full duplex RS232, shall support only 8 card readers.
16. The controller shall incorporate integral on-board auto-answer, auto-dial modem for call back. If a network connection is present, the dial-up connection shall serve as an alarm backup in case the network is busy or fails. There shall be a provision to call alternate telephone numbers when alarms occur. For additional security, the control panel in a dial- up configuration shall dial the PC back before receiving any data. The control panel shall provide a response time from card presentation to GO/NO-GO indication, not to exceed one second, regardless of the number of card readers active in the system at any time.
17. The control panel shall provide control of up to 14 scheduled or event driven relay outputs.
18. The control panel shall have dynamically allocated RAM memory to store up to 125,000 card ID numbers up to six digits in length. Additional RAM modules shall be available in 3MB and 7MB, to achieve the 125,000-card memory requirement.
19. The control panel shall Store a minimum of 4,000 card access transactions when offline from the network.
20. The control panel shall incorporate built-in data backup in the form of a lithium battery or “Super cap” to last 168 hours.
21. The control panel shall have a 7-Amp hour Gel Cell battery for standby operation.

22. The control panel shall incorporate a built-in, real-time clock for providing scheduled event programming. Clock shall be initially set and subsequently updated from the PC or hand- held programmer described above.
23. The control panel shall be able to run on low voltage: 14-17VAC or 12VDC. Power consumption shall not exceed 600 mA (excluding card readers).
24. The panel shall support a palm application for control panel diagnostics. The user shall be able to use it for trouble shooting purposes.
25. Contact Point Supervision
    a. The control panels shall support supervision of contact points to detect any tampering with the equipment, including breaks and/or shorts in the cable between the reader controller and the supervised input point.
    b. To detect trouble in the circuit, terminating resistors shall be installed within the contact. These resistors shall allow the controller to distinguish between a contact point opening or closing from the circuit opening or shorting.
    c. The controller shall support three methods, or types of supervision.
        1) Type 0: Both series and parallel resistors at the contact
            a) Door Held Open (DHO) or Door forced Open (DFO)
            b) Contact Secured
        2) Trouble Open (break in the circuit)
        3) Trouble Short (a short in the circuit)

C. Reader Interface
1. Each reader in the system shall have a dedicated reader interface.
2. The reader inter face shall support multiple read head technologies including:
    a. Proximity
3. The reader interface shall contain and control up to two single pole/double throw 1-amp mechanically latching relays.
4. The reader interface shall provide six supervised or unsupervised contact inputs (in addition to the 16 supervised or unsupervised inputs on the controller).
5. A noise suppression kit shall be included with the reader interface.
6. The reader interface shall communicate via RS-485, two-wire cable up to 4,000 feet from the control panel to which it is connected, using 18AWG, I pair, stranded, shielded, Twisted.
7. The reader interface shall support programmable degraded mode by allowing up to four (4) different facility codes at each controller location. Degraded mode for an individual reader shall be programmable via the PC system software E.g. door is not).
8. The reader interface shall support an audible GO signal.
9. The reader interface shall support multi-color LED for GO and NO GO indications.

D. Optional Devices
1. The system shall provide expansion board with 12 additional relays and 8 contact inputs.
2. The system shall provide memory expansion boards with 3-7 MB memory.
3. The system shall provide on board modems and IP modules.

E. Pre-wired Enclosures - The control panel shall be housed in a pre-wired metal enclosure, which shall accommodate one Reader Controller, 8 RINX Reader Interfaces, and shall include:
1. Pre-wired 16/32 VDC 100 VA power supply.
2. Pre-wired 12/24 VDC 100 VA power supply.
3. Pre-wired (2) 7 amp-hour batteries.
4. Pre-wired 12VDC 4.0 amp power supply.
5. Pre-wired Communication Housing.
6. Individual 1 amp fusing for reader, egress device, electric door lock.
7. Pre-printed and color coded wiring termination labels.
8. Optionally, there shall be a 6 amp 24 VDC lock power supply/charger with Emergency Relay and (2) 7 amp-hour batteries.
9. Dimensions shall be 30" H x 30" W x 8" D, with two-inch EMT knockouts and locking double door.
10. When more than 8 readers are connected to one RCNX Reader Interfaces 9-16 shall be housed in a GENC-RINX enclosure with specifications identical to those listed above.

2.5 Accessories

A. Request-to-Exit Motion Detectors:
1. Motion detectors shall be used to shunt alarm signals when exiting. Detectors shall not be used to unlock the access door.
2. 12VDC Request-to-Exit (REX) sensors:
   a. Field adjustable for coverage.
   b. Form C relay output for signaling to Controller.
3. Door Position Switches/Contacts:
   a. Hermetically sealed magnetic reed switch.
   b. Contact & magnet housing shall snap-lock into a ¾" hole.
   c. Provide 45-degree condolettes to enclose and protect cabling from door contacts/switches. Condolettes shall be placed as close to the contact/switch as possible.

B. Hardware Specifications
1. Control Panels
   a. Power – 12-24 VDC, 12 Amps
   b. Power consumption – 600 mA
   c. Ambient temperature – 0º to 49º C or 32º to 120º F
   d. Humidity – 10% to 85%
   e. Maximum distance to PC – 50 feet RS232 communication
   f. Recommended cable – 22 AWG/3 conductor stranded, shielded
2. Reader Interfaces
   a. Power – 12-24 VDC, 12 Amps
   b. Power consumption – 600 mA
   c. Ambient temperature – 0º to 49º C or 32º to 120º F

d. Humidity – 10% to 85%
e. Recommended cable (connecting to control panels)– 18 AWG/3 conductor stranded, shielded
f. Recommended cable (connecting to read heads)– 22 AWG/3 conductor stranded, shielded
g. Maximum distance (both to controller board and read head) – 500 feet

3. Accessories
   a. Door Contacts
   b. Voltage: - 100 V AC/DC max.
   c. Current: - 0.5 A max.
   d. Power: - 7.5 W max.
   e. Loop type: Closed – N/O.
   f. Mounting: Recess mounted.

2.6 Access Control System Software (only is software is not existing)

A. System Communication: System shall provide an interface (Communication Interface Module or CIM) to issue all database changes to the Reader Controllers. This software module also shall have the ability to gather all the information (transactions) from the Reader Controller and store it in proper history files.
   1. The CIM shall reside on any workstation or server. On a single user system, the CIM shall reside on a workstation, but on a multi user system that uses multiple CIMs, it shall reside on any workstation or server.
   2. The communication between the CIM and the controllers shall be through direct cabling, phone lines or TCP/IP communication protocol.
   3. All serial ports to which the controllers are connected shall be configured using an easy to follow menu. All the COM PORT status messages shall be color-coded.
   4. An operational tab shall be provided to tell the CIM to check for the changes that are made in the database.
   5. The CIM shall have a specific window, which shall display all the Controllers connected to a COM Port. The user shall be able to select one particular Controller and get all the information pertaining to that device. (E.g. Device number, channel, address, phone number, connection status etc).
   6. The user shall be able to schedule automatic updates of controller panels. The CIM shall be able to communicate with the control panels located at remote locations via a dial up modem, at scheduled intervals and update the data in the controller memory.

B. Communication Management: System shall facilitate a program that controls the communication between the CIM and the workstations.
   1. Application shall be in charge of directing transactions and alarms to proper workstations.
   2. Program shall be capable of sending alarms of e-mail messages to legitimate e-mail accounts.

C. Access Rights: Software shall allow for assignment of the access rights to badge holders. The access right is the combination of what "Areas" the badge holder can go (badge and elevator readers) and when the badge holder can go there (time zones). Each badge holder shall be allowed multiple "Area" access rights. Each access right shall be allowed to have a different time schedule.
   1. Software shall automatically load the proper access rights into each field panel without any operator intervention. There shall be no limits on the number of access rights (who goes where and when) by the system design.
   2. Access Privilege Expiration: Include the ability to force an expiration of access privileges in any or all areas with a simple mouse clicking procedure.
   3. Extended Access Privilege: Include the ability extend the access privileges in any or all areas with a simple mouse clicking procedure.

D. Event Triggers: System shall provide flexibility when associating action items with time zone programmed events, i.e. card transactions with contact reporting and relay activation.

E. System Management: System shall provide a tool that will integrate and categorize the Owner's data and at the same time the user shall be able to simultaneously monitor and maintain a secure working environment.
   1. The system shall contain the definition of all intelligent field control panels (i.e. Reader controllers (RCs), card readers, contact inputs etc). There must be a provision to label each device with at least a 20 character alphanumeric description to easily identify each component.
   2. System software shall be designed to allow operational management and control at many "tiered levels" with the apex of control being in the hands of a "Global Manager". The "Global Manager" shall have administrative authority for the entire system and delegate administrative responsibility as follows:
      a. Area Management and Area Sets: Provide a functionality to divide the protected facility into logical areas, which can be either one physical location (e.g. main lobby) or many logically related physical locations (e.g. All the computer rooms in 12 different cities). System administrators shall be assigned jurisdiction in one or more areas through assigning proper security privileges to the areas. The system shall provide a functionality to organize areas to area sets to provide segmented security.
   3. Categories: Within one area or many areas, administrators may only have jurisdiction over certain categories of cardholders or devices:
      a. Cardholder Categories: The system shall permit the administrator or authorized operator to create cardholder categories. The categories shall be used to define access rights for certain types of employees, such as "Temporary workers" or "IT employees". All the categories defined by the user should be available in the form of a drop-down menu for the ease of modification.
      b. Devices: The system shall allow assignment of operator privileges to be restricted to programming only devices in certain "areas" such as "turnstiles", "handicapped access points", "motion detectors" or "building management" related devices.

4. Door Types: The system shall support a minimum of eight user-definable door types within an area. For example, in a lobby area, it shall be possible to restrict most employees to "turnstiles", and only physically challenged employees would be permitted to access "handicap gates".
5. System State: The system shall have the ability to place an area in various user-defined states such as normal access, fire emergency, strike lockout, etc, thereby changing the access rights to the respective areas without having to change individual cardholder access privileges.
6. Holidays and Holiday Sets: The system shall allow the user to define the holidays according to the specific needs. There shall also be the facility to group holiday dates into specific grouping so that, time zone assignments can include all the individual holidays in that. Holidays shall be organized into holiday sets for easy management.
7. Time Zones: Time zone definitions shall include starting time, ending time, days of week and holidays. Time shall be definable in either AM/PM or 24-hour (military) time. Maximum time zones that can be defined in a system shall be unlimited.
8. Site Codes and Site Code Sets: The system shall allow to program readers in degraded mode. In degraded mode the system should allow access to cardholders when the controller board has lost data communication with the Reader Interface.
    a. The system shall provide a functionality to assign a number ranging from 1 to 1,000,000 to each site.
    b. Cardholders shall be assigned one of these numbers for a specific site while the same number should not allow access to another site.
    c. Any lost communication shall not interfere with access being granted as site codes are downloaded and retained in the reader memory.
    d. When site codes are programmed and downloaded to the controller, the board should check for validity of that site code against the card that has been read. If the site code does not match what is stored on the board then access should be denied.
    e. Cards that are purchased from Schlage Security Management System shall have the site codes encoded on the card. The site codes shall be able to organize into site code sets.
9. Call Back Numbers and Call Back Sets: The system shall provide a facility to define call back numbers for modem communication between reader controllers and the CIM. The user shall be able to put the Call Back numbers into Call Back Sets.
10. Hardware Definitions: The system shall allow the configuration and programming of the system hardware by easy programming. The user shall be able to define workstations, CIM, CIM Ports controllers, readers, relays and contact points. All the information entered shall be editable using an easy to use interface.
11. Device Status: The operator shall have the option to view a single device's state at any point off time. The user shall be able to request and receive the status from any reader, relay or contact. The status is displayed in a dialog box when it is received.

F. System Security: The system shall be secure both in its operation and administration. The system shall offer ample flexibility for the administrator to establish and customize any level of security by assigning security permissions to group of operators. The individual operator shall be able to log

into the system using a unique operator ID and a password associated with that operator ID. The "Administrator" of the system may set the following rules and standards:

1. Login Requirements
2. Logging into the system shall be restricted using User ID and password. The user ID shall be of alphanumeric characters. It shall be a unique ID and cannot be duplicated. Password also shall be of alphanumeric characters but shall be case sensitive.
3. The administrator shall be able to define the expiration date of the password. The administrator shall have the ability to set a pre-determined period of days in advance to warn the operators upon login, as to how many days remain before their passwords expire. The administrator shall also have the ability to set the password valid for an indefinite amount of time.
4. The administrator may disable an operator's password at any time by merely checking a box for that function. The administrator may also set the following conditions for disabling operator passwords automatically:
    a. After a programmable number (1-999) of consecutive illegal login attempts, e.g. wrong operator ID or wrong password for that operator ID.
    b. After a specified number (1-999) of days of non-usage of the system by the individual operator.
5. The administrator shall also be able to pre-set the system to automatically lock out the operator workstation currently in use by the offending operator for a specified or indefinite period of time, until the administrator resets the password.
6. Operator Security Groups: The system shall provide a functionality to define security groups, assign privileges and place individual operators into these groups. Though one operator shall be placed into only one security group, he/she shall be switched to a different security groups with one mouse click. These security groups shall in turn determine the security privileges of the operator. A security group shall have at least the following permissions:
    a. Whether multiple logins are allowed as opposed to only being allowed to login to the system a single time.
    b. Whether the operator has to exit the security system in order to return to the Windows operating system.
    c. What system software programs are available to the operator in this specific security groups.
    d. What privileges are extended to the operators in a specific security group as it pertains to accessing various elements of the System Data Base and in performing assigned function's.
7. Operator Privileges - The administrator shall have the ability to assign permissions to operators as far as gaining access to and exercising database functions. Once an operator has logged into a given workstation, the system shall display only those programs to which the operator has at least Read only permission. The system shall offer tighter security by providing the functionality to assign privileges not only to programs and reports but also to fields like areas, area sets, cardholders, cardholder categories and all user defined fields.
8. Default Security Privileges - The System Security module shall allow predefining the default permissions settings. These settings shall only affect privileges for new security groups that

are added. It shall not cause any changes to permissions assigned to existing groups. To access these settings, the operator must have Administrative privileges. Permissions for new groups shall default to these settings (set to none), however these settings shall not be assigned to the System Administrator group or members of the security group that added the field. The permissions can be defined on a need to know basis. Privileges are defined as follows:

a. None – No ability to view or edit a particular field in the database (e.g. Encoded number in the cardholder file)
b. Read Only – Only the ability to view the contents of a particular field in the database. The Edit option for the related programs or fields shall be disabled.
c. Read/Write – The ability to both view and edit a particular field in the database, except those fields reserved for operators with "Administrative" status.
d. Administrative – The ability to perform all system-wide functions (functionally same as Read/Write permissions).
e. The above privileges shall be applied as follows:
    1) Area Sets - The Administrator shall have the ability to prevent a group of operator from viewing, modifying or deleting (specific) Area Sets while allowing them to insert new Area Sets to the database.
    2) Categories - The administrator shall have the ability to restrict the operator from viewing, editing or deleting cardholder categories. E.g. Training department, Technical support department.
    3) Cardholder Fields - The operator privileges shall be extended only to individual user-defined fields in the cardholder database, E.g. "Keypad ID", "Stamped ID".
    4) Override Sets - Within the assigned area and categories the operator shall be given permissions to override standard system settings to perform such functions as unlock doors, shunt alarm points, turn on or off control points normally operating on a schedule.
    5) Device Types - Within a defined "Area", the operator privileges shall be extended only to specific user-defined categories of devices, E.g. "Handicapped card readers", "Turnstile card readers", "Life Safety sensors", "Environmental controls", "Vehicular gates", etc.
    6) Filters - The Administrator shall create filters for transactions and operator privileges shall be extended to the ability to delete or view selected transactions as they occur in real-time mode.
    7) Applications Launcher - The operator privileges shall be extended only to selected application programs such as "Alarm Monitor", "Alarm Graphics", "Transaction Monitor", "CCTV Camera Control", "Cardholder Definitions" etc. Setting permissions to none for any item shall remove it from the System Launcher screen.

G. Reports: Assigning appropriate privileges to operators shall restrict generating or running reports.

H. Badge Layouts: Badge layouts shall be protected by assigning appropriate privileges.

1. New records (new module, report, user defined cardholder field) that are added to the database shall have none permissions until the Administrator modifies the permissions.
2. The operator shall be able to make the selections by placing checkmarks in the boxes as opposed to highlighting the text in order to prevent erroneous assignments, as well as for the ability to make multiple selections.
3. The assigned fields shall display in the permission's color (None, Read Only, Read/Write and Administrative).

I. Start-up Programs:
1. The programs such as CIM, SP, CCTV, History Archive, Universal Triggers, Alarm Monitor and Alarm Graphics etc (both Alarm Monitor and Alarm Graphics shall not be added as the start up programs at the same time) shall be set to launch before the operator is logged in to the system.
2. The administrator shall be able to select any programs from the above list and set to launch before the operator log in.

J. Cardholder Creation and Management: The system shall provide an easy to use interface to add, delete or modify cardholder information effortlessly. With the use of wizards the user shall be able to input and retrieve data regarding area access, active, retired badges and cardholder categories etc.
1. The cardholder information shall include the following fields for each badge being issued.
   a. Cardholder's first name and last name.
   b. Activation and expiration dates (spanning years).
2. A unique encoded number – The number that is encoded within the card and used as a means of identification. The number of digits encoded shall be capable of containing the equivalent of a social security number (e.g. 123-45-6789 = 123456789) plus a 2-digit issuance code (See Badge Issuance Number below)
3. A variable keypad number that the user can select from 1 – 9999.
4. Badge Technology – The technology in use for this particular badge, to be selected from a "drop down" list as follows:
   a. Proximity

K. Badge Layout: The visual representation of the badge, as it shall be printed.
1. Areas and area sets the cardholder has access to.
2. The following fields shall be available for the use at the administrator's discretion:
   a. Stamped ID – The number that is "heat stamped" on the card (not the encoded number)
   b. Badge issuance number – Upon entering, the default for this field shall be set at "0". This number can be incremented by the operator if the badge is reissued because it is either damaged or lost.
   c. Badge Status – The current status of the most recently issued badge. This shall be selected from a "drop down list" as follows:
   d. Active – Badge is currently active
   e. Lost – Badge has been reported missing

f. Stolen – Badge has been reported stolen
g. Destroyed – Badge has been rendered unusable
h. Suspended – Badge has been temporarily suspended

3. System shall also provide optional user definable badge states.
   a. Door States – The types of doors that the Cardholder has access to (e.g. Normal, handicapped).
4. The system shall provide optional user definable fields
   a. Badge Created: Shall be automatically generated by the system during badge printing.
   b. Date Badge Printed: Shall be automatically generated by the system during badge entry.
   c. Date Badge Modified: Shall be automatically generated by the system during subsequent badge modifications for access or categories for that cardholder
5. The system shall allow the user to duplicate specific user definable information like area access, categories, badge layout, technology etc whereas, fields like encoded id, stamped id, portrait, signature etc will be unique to each cardholder. This feature shall be available with in a single mouse click.
6. The system shall also allow the creation of templates that contains general cardholder information like area access and categories. Encoded id, stamped id etc shall be unique for each cardholder.
   a. For example, the system shall allow the creation of a template for all the members of the engineering department or sales department of a company and save it in the database. When the user creates a cardholder and assigns badge, the user shall be able to use the corresponding template.

L. Allow multiple credentials per cardholder. Cardholder data shall be modified and deleted directly from the main screen or by using menu, hot keys or tool bars. Include the following attributes:
   1) The option to retire active credentials whenever a new badge is initiated.
   2) Functionality to automatically choose a badge technology and badge layout whenever a new badge is added.
   3) While deleting multiple cardholders at the same time, any attempt that fails shall be added to a list and presented to the operator with the cause of error.
   4) Functionality to mass change access control fields for activation/expiration dates, access block and anti-pass back.
   5) Cardholder search wizard to make finding cardholders a simple process.
   6) Functionality to make multiple selections in the cardholder search window by holding down the Ctrl key.
   7) Provide options to include time zone reference.
   8) Upon editing card information, the updated information shall be sent automatically to the appropriate access control panel, when hardwired, with no other user intervention. If the scheduler is used, then the card updates shall be sent based on scheduling.
   9) The system shall allow the user to add e-mail addresses of the cardholders into the database.

M. Person with Disability: The system shall allow additional access to doors for physically challenged cardholders.
   1. When a new cardholder is added to the system, the operator shall have an option to select a specific field with Person with Disability option. The event triggers for LED Green transaction shall be programmed in the System Manager. The Duration field shall allow for a longer transaction (e.g 30 second versus the standard 5 seconds). The field, Person with Disability, shall also be added to the All Cardholders and Cardholder by Category grids of System Manager. The value shall default to false. The CIM shall be modified to update panels with the Person with Disability feature when a cardholder record is downloaded. Privileges to this field shall be assigned in the System Security module under cardholder field permissions.
   2. Online Credentials: The system shall provide the ability to assign online credentials to cardholders that communicate directly with the controllers.
   3. Offline Credentials: The Schlage Security Management System shall support offline readers which do not communicate with the host controller directly. The user shall be able to create necessary downloadable files and upload to a pocket PC. The data shall be transferred to a PDA by connecting to the serial communication port of the PC. The programming of doors shall be accomplished by connecting a CIP (Computer Interface PAK cable) from the laptop/palmtop to the I-Button ports of the lock.

N. Assigning Area Access: Provide functionality to define cardholder's access to selected Areas and Area Sets.
   1. Provide the ability to define specific time of access.
   2. Access Control function shall include validation based on time of day, day of week, holiday scheduling and positive verification of site code, card number or PIN number verification.
   3. Provide a template of defined access level detail, where changes can be made to the template and saved as a new access level.
   4. Provide an option to create user definable area states and door types and there by giving the cardholder access at special circumstances.
   5. The system shall also provide the user to define access control templates while defining area sets. When a new area is added to the area set, templates of access level detail, where changes can be made to the template and saved as a new access level template.

O. Portrait Capture: Provide ability to store digital images of the cardholder. One cardholder shall have only one image attached to one record.
   1. The images shall be taken using a digital camera or a TWAIN device. The system shall also provide the functionality to save the images in the hard drive. The operator shall be able to retrieve the files for future use.
   2. The system shall provide necessary tools for image editing like cropping, resizing centering the image etc.

P. Portrait Enhancement: The system shall provide a functionality to enhance the cardholder portrait. There shall be a utility, which enables the operator to improve the quality of the picture by adjusting the brightness.

1. The operator shall be presented with 15 different views of the cardholder portrait. The "Increase" and "Decrease" buttons shall help the operator to make the picture lighter or darker.
2. The operator shall be able to access this utility from the program where he/she defines the cardholders and captures their portrait.
3. The system shall also provide a transparency preview of the image.
4. The system shall also allow the user to edit the image through a third party application. Editing an image shall be limited to changing background color, resizing the image, cropping etc.

Q. Portrait Exporting: Provide a functionality to export cardholder portraits in JPG format.
1. The operator shall be able to copy the files to a folder that exists outside the system software. The operator shall be able to select the directory to which the portraits are being exported.
2. When exporting files the user shall be provided with an option to decide the file naming convention.

R. Signature Capture: Provide ability to store a digital signature of the cardholder. Each cardholder shall have only one signature attached to his/her record.
1. The operator shall be able to use an already saved signature or the system shall provide the option to capture a fresh one using any TWAIN device.
2. The system shall provide necessary tools to edit the signatures like cropping, centering etc.

S. User Definable Fields: The system shall provide a functionality to create additional User Definable Fields that shall be applicable in certain programs. A few examples will be Nickname, Social Security Number etc.
1. The user shall be given an option to select the type of fields from a variety of choices like:
   a. Look up list
   b. Boolean
   c. String
   d. Integer
   e. Date
   f. Time
   g. Date & Time
   h. Notes
2. When defining a user definable field, the system shall give the user the flexibility of deciding whether the field is pertinent only to cardholder database or guest pass database or both.
3. The user shall be given an option to make the new fields "Required".
4. The user shall easily modify the user definable fields. The user shall be able to resize, align and position the fields either by dragging the edges of the fields or by entering specific values of dimension.
5. The system shall provide a way to organize the newly created fields along with the predefined fields that already exist in the program.
6. The system shall display the predefined fields in a programmable font color.

T. Designing Badge Layouts: The system shall provide functionality to design and print badge layouts.
1. The features of the badge-designing program shall include the ability to use background color, background image, inserting pictures, logos, signatures and a variety of fields that the operator uses while defining a cardholder.
2. The user shall be able to use professional layouts.
3. Images of different formats (JPG, GIF, BMP) shall be inserted into the badges.
4. The user shall have the option to make the background of the image transparent.
5. The user should be able to customize the badge by making the following selections:
   a. Adding any cardholder fields.
   b. Text style.
   c. Font style.
   d. Font color.
   e. All upper caps.
   f. Horizontal alignment.
   g. Vertical alignment.
   h. Text background color.
   i. Border setting.
6. The program shall provide a functionality that allows the user to test the portrait or signature's transparency effect by changing the background color.
7. The program shall provide an easy way to edit all the information entered into the badge.
8. The user shall be able to view both sides of a badge.
9. The program shall save the changes automatically while changing the sides or moving to another layout.
10. The program shall also support magnetic stripe encoding. The program shall provide three tracks for the magnetic stripe cards. The user shall be able to insert the cardholder information like PIN or Encoded ID or hard coded text (the user shall be able to type in the text) into these fields. Each field added shall be separated with a separator symbol.
11. The program shall provide a wizard that helps the user to select the fields he/she wants to insert into the magnetic stripe fields.
12. The user shall have the option to duplicate the badge layouts with a single mouse click.
13. The badge layouts shall be secured using the system security. Only operators with Read/Write permissions shall be able to modify or create badge layouts. The permissions set to a badge layout shall affect an operator using the badge layout in the Cardholder Definition, Badge Queue and Guest Pass System.

U. Printing Badges: Once the badge is created the user shall be able to print it from the badge creation program.
1. The badge creation software shall be able to override the default printer settings and use the dimensions of the badge, which in turn will decide which layout to use while printing.
2. The program also shall provide an option to print dossier reports.
3. Badge Automation
4. The system shall provide a functionality that enables the operator to automatically choose a badge layout and a badge technology whenever the user wants to add a badge to a cardholder record.

V. Export and Import Badge Layouts: The system shall have the ability to export and import badge layouts.
   1. The system shall have the functionality to save the badge layouts as binary files in a specified folder whenever they are exported or imported.

2.7 Transaction and Alarm Monitoring

A. Transaction Monitoring: The software shall include a real time display of all or selected transactions in the system as they occur.
   1. The screen shall display substantial information about each transaction (e.g. cardholder, card number, access granted or denied, location, etc.). The operator shall be able to see only those user definable fields, which he has been given permission to view.
   2. The Transaction Monitor shall be split into two sections: (1) All cardholder transactions, (2) All device and operator transactions.
   3. The system shall provide a feature that enables the CUSTOMER to set filters for unwanted transactions. The software shall allow the CUSTOMER to select specific cardholders or devices that generate the transactions.
   4. The software shall provide functionality to save the transaction monitoring screens and auto load them whenever a transactions occurs.
   5. The software shall have the capability to dial-up the controllers located at remote locations via a modem and receive transactions.
   6. There shall have a facility to view a recommended minimum of five (5) on-line transaction-monitoring screens at one time, at a single terminal.
   7. The user shall have the ability to customize the online monitoring screen into two individual partitions. One displaying cardholder transactions and the other one displaying device and operator transactions. The operator shall also have the flexibility of turning off any of these transactions and view only one type of transactions.
   8. A pause button shall be provided which shall enable the operator to stop the display of selected transactions.
   9. Transactions may be color-coded according to the dictates of the administrator. Color- coding shall extend to both the background color as well as text (foreground) color.

B. Viewing Previous Transactions: Include ability to view previous (past) transactions from the transaction monitor screen. The user shall have the ability to set a "filter" that shall select what type of event(s), what cardholder(s) and what device(s) shall appear while viewing past transactions. When the scrolling process is complete, the operator shall be able to invoke a single keystroke or mouse click to return to the current transaction screen.
   1. Link to Cardholder Database - System should allow the operator to right click on any access transaction and bring up the database profile of the cardholder in question, including a thumbnail of the cardholder's portrait.
   2. Link to Recorded Video - The operator shall be able to right click on any transaction, if there is a camera associated with the access control or contact activation location, the operator will be presented with a "Play Video" button. The operator shall then be able to link with

the digital video recorder and play back recorded events from that location. This should be accomplished through a single mouse click. A digital video recording system also shall be available with the access control system to support this feature.

C. Alarm Processing and Monitoring: The system shall permit the programming of alarms (contact inputs) with a priority level and instructions, if any, to be followed when the alarm occurs. The system shall offer up to 126 levels of priority, with 1 being the highest and 126 the lowest. Each alarm point shall be addressed within the system by a unique user defined name.

1. All system transactions shall be defined as alarms.
2. The operator shall be able to view, acknowledge and secure alarms. The system shall alert the user immediately upon receipt of an alarm by popping up an alarm window on-screen. The alarm window shall contain the following information: cardholder information, date, time, transaction description, priority level, device number, and reader controller number, and how many unacknowledged alarms are in memory.
3. In a multi-user environment, the user shall have the option of directing incoming alarm signals to an alarm display terminal and/or to a specific individual (identifiable via log-on ID) for the purposes of reviewing and initiating the alarm dispatch function. Alarms emanating from a field panel located in a remote facility shall be transmitted immediately through the remote controller's IP addressable device or a dial-up modem.
4. The system shall also have an audio alert (e.g. beep) that an alarm has been received. The administrator shall be able to customize the audio files according to the type of alarm. If more than one alarm is received at one time, the system shall put the higher priority alarm on-screen. The operator shall be able to silence the alarm by pressing any key. The next alarm shall appear immediately.
5. The operator shall be able to right click on any alarm and view the portrait of the cardholder in question. The operator shall also be able to link to the cardholder database and get the information regarding the cardholder that enable him/her to take appropriate access control decisions.
6. If there is a camera associated with the alarm/contact point in question, the operator must be able to receive “live video” from the scene with a single mouse click.
7. The operator, in addition to receiving live video from the scene, shall also have the ability, via a single mouse click, to retrieve recorded video of the scene. The recorded video shall contain a user-defined amount of video frames before the event and subsequent to the event. It is essential that the system shall allow both the live video and the recorded digital video being displayed “side-by-side” on the same computer workstation.
8. Provide ability to acknowledge any alarm or reader activity based on priority.
9. Provide the display of system activity with higher priorities displayed at the top of the list.
10. Alarm Monitor shall continue displaying an alarm, until it is acknowledged and secured. For example, certain alarm transaction types shall relate to normal physical state of a device. When the normal state changes, an alarm may be triggered. E.G. A contact alarm for a door being forced open. This alarm shall remain in the monitor until the contact device has been secured.
11. The user shall also be able to view instructions, if any, for responding to a particular alarm. This shall be achieved by a single mouse click. The instructions given to the operator shall be

presented on a single screen in Windows graphical interface format. There shall be a functionality to dispatch instructions via sound files (.wav).

12. The operator shall be able to view the alarms that occurred in the past without exiting the online monitor.
13. Varying alarms shall be color coded according to the dictates of the administrator. Color-coding shall extend to both the background color as well as the text (foreground) color.
14. The system shall allow the configuration of different door alarms based on the activity at that door. The alarms shall be caused by any of the following activities.
    a. Door Forced Open
    b. Door Held Open
    c. Access Under Duress
    d. Access Denied
    e. Alarm Acknowledgment
15. The operator shall be able to direct individual alarms to specific groups of PC/workstations on the network. The user shall have the ability to define 32 different groups of PC\workstations, with up to 15 PC/workstations in a group. Each PC/workstation shall be identified through the workstation name. Each alarm point may be assigned to a specific group of PC/workstations.
16. If the first assigned group does not acknowledge an alarm in a period of time defined by the user, the alarm shall be rerouted to another group of PC/Workstations on the LAN, if available.
17. As part of establishing standards for alarm acknowledgment, the user may set parameters that force the operators to enter comments either free-form, or by prompting the operator by issuing "labels" to which the operator shall enter a response. The operator shall either select from a menu of “predefined” responses or respond free form. There shall also be the facility to store these responses in the historical logs and add to them at a subsequent time if the situation warrants follow up.
18. The administrator shall also force the operator to login before acknowledging the alarm. Only after these criteria are fulfilled can the alarm be considered acknowledged and the operator shall be allowed to return to other system functions.
19. The operators shall be able to perform override tasks that are attached to the alarm display when an alarm is defined. These tasks include locking/unlocking doors, changing system state to “Lockdown”.

D. Alarm Graphics: A graphical depiction of the alarm shall be presented to the operator in the form of a blueprint and/or illustrative photo of the scene of the alarm. Icons may be imposed on the graphics whereby the operator can right click on the point of alarm and have immediate access to all of the following:

1. Audio Playback - An audio playback of dispatch instructions via a “Windows Wave File” (.wav).
2. Text Interface - A text interface whereby the operator can enter comments regarding actions taken. The operator shall either select from a menu of “predefined” responses or respond free form.

3. Live Video – If there is a camera associated with the alarm/contact point in question, the operator must be able to receive "live video" from the scene with a single mouse click.
4. Digital Video Playback – The operator, in addition to receiving "live video" from the scene, shall also have the ability, via a single mouse click, to retrieve recorded video of the scene. The recorded video shall contain a user-defined amount of video frames before the event and subsequent to the event.
5. Manual Overrides – The operator shall be able to execute the defined manual override commands with one mouse click whenever he/she is alerted with an alarm.
6. Monitor Device Status – The operator shall be able to monitor the status of devices when transactions or alarms occur by double clicking on the icon.
7. The system shall support user programmable high-resolution color graphic map displays that are capable of showing the floor plan, location of the alarm device and alarm instructions. The maps can be created in BMP format and shall be capable of being imported from other systems. The system shall provide the ability to drop dynamic object icons to drawings. These icons shall allow the system operator to perform task command related to the object. All the defined alarm graphic maps shall be displayed on the operator's monitor.
8. There shall be a facility to define different icons for 4 (four) different alarm states:
    a. Default
    b. Unacknowledged and Unsecured
    c. Acknowledged but unsecured
    d. Unacknowledged but secured
9. Include functionality to create custom animated graphics (icons) for different alarm states. The user also shall be able to edit or modify the animated graphics.
10. When an alarm is activated the operator shall be interrupted with the change of an icon state (using animated graphic) and/or with an attached sound file (.wav). The operator shall be able to scroll down to the icon's location in the map
11. Alarm Graphics workstations shall be able to communicate with one another and communicate to any number of clients that are connected to the graphics system.

E. Manual and Automatic Overrides: The system shall allow manual and automatic control of selected output points. Manual panel control shall include energize/de-energize options for output points as well as the option to override any schedule changes in the output state.
1. Manual Overrides: The system shall provide a facility to manually change a device's normal function, possibly to allow temporary access to an area, exit in an emergency situation or as an added security to an access or exit point.
    a. The administrator shall be able to define the override tasks in such a way that the commands may be sent to several devices simultaneously (e.g. unlocking all the doors in an emergency).
    b. The operator shall execute these tasks manually via executing a series of keyboard commands by opening the Manual Overrides pull down menu and clicking on the appropriate override tasks.
    c. There shall be the functionality to establish a conditional, "if A occurs then B shall occur", relationship between an event and an activation of some output (e.g. access

denied> relay activation). For example, an access denied into an area can trigger the lights to go on).

d. Manual Override Command To Stop An Activated Schedule – The system shall allow the user to issue a manual override command to stop a currently activated schedule (e.g. door unlock).

2. Automatic Overrides: The system shall provide a way to override certain tasks automatically at a regular basis (e.g. unlocking the main lobby door during normal business hours).
   a. The user shall be able to define the time zones according to the CUSTOMER'S needs.
   b. In the event of computer or network failure, Automatic Device Override programming shall continue to function as programmed in the off-line mode. The off-line programming shall be universal and intelligent. Groups of up to 16 intelligent field panels shall be connected to a single Master intelligent field panel. The Master intelligent field panel shall then control off line Automatic Override so that an event at any given field panel can trigger an output at any other given field panel.
   c. Activate An Automatic Override Schedule By A Valid Access – The system shall provide a secure way to unlock an automatic scheduled door. A valid credential access shall be required to trigger the readers/offline locks scheduled to unlock during a scheduled period.
3. Integrated Guest Pass: The Access Control System shall also provide an integrated, personal computer based system, offering the function to pre-schedule expected visitors and grant temporary access by issuing Access Control Badges and Name Tag.
   a. System shall be capable of registering an expected guest to the system and the guest information shall be stored in the Guest Pass Database until the user deletes the record completely. The guest information shall be retained in the Guest Pass Database for the ease of pre-scheduling returning guest and report generation.
   b. System shall allow the administrator to set the requirements (what information is required for giving access rights to the visitors) according to the customer's needs. The system shall provide a step-by-step wizard, which helps the user to select the required fields.
   c. The system shall also provide an easy to use interface to add a guest into the system. The steps that the user sees while adding a guest shall be depending on the requirements set by the administrator. The guests added to the system shall be displayed in the main window of the system once the window is refreshed dynamically.
   d. The applications capabilities shall include, adding a guest, signing in a guest, signing out a guest, editing guest information, capturing and viewing images and signatures and badge and label printing.
   e. The system shall force authorization of the guests added to the system before giving access control permissions. All unauthorized guests shall be added to a pending list.
   f. The system shall be capable of generating the following reports:
      1) Expected guests and arrival dates, host, area to be visited, expected arrival time.
      2) Expected guests today, host, area to be visited, expected arrival time.
      3) Access control badge usage by Guests.

4) Guests present in facility.
5) Signed out guests

g. The system shall allow User Defined Fields to be implemented as required.
h. The system shall provide for the optional recording of an electronic signature and digital photograph of the guest.
i. The system shall provide a way to notify the host regarding the arrival of the guest via e-mail.
j. The system shall use visitor badges with unique encoded id. The user shall be able to type in the text manually or generate automatically.
k. The user shall be able to set maximum and minimum values for the automatic generation of encoded id. When the user creates a badge, the system shall choose an unused and unique id between the values set in the encoded id settings. As the user creates more badges and once the encoded id reaches the maximum value set, the system shall use the starting value set in the encoded id settings. If that value conflicts any existing badge's encoded id, the system shall use a new value, which shall be unique and unused. At the same time the system shall also provide a way that allows the user to set the starting and ending encoded id values manually.
l. The operator shall be able to set different locations and add pending guests (the guests who don't have access control permissions) to any location. The system shall allow the user to sign in (give access control rights) the guest only to the location where the Guest Pass System is located.
m. When there are multiple locations set in the system, the system shall allow the operator to specify one location as the global location. The guest information in the global location can be viewed from any location set in the system.
n. While creating badges, the user shall be able to use default badge layout, technology and printers. The system shall also allow the use of default label layout and printer.
o. The operator shall be able to view signed in guest, pending guest, signed out guest and location of the guest in the main window of the system. The system shall also display all the user-defined fields in the main window.
p. The system shall use different color schemes for valid guest, about to expire guest and expired guest.
q. Denial of access after x number of visits when a guest has reached the maximum visit count specified in the Guest Pass Settings he/she shall be denied access and cannot be signed in. To allow the guest to override the maximum visit count, an administrator must use the Guest Pass Settings program or their visit count must be reset to 0.

F. Guest Pass Locations: In the Guest Pass System location shall refer to the site where the computer with the Guest Pass System is installed and used. The system shall provide an option for the administrators to add, delete, modify or select a location.
1. Each Guest Pass Locations shall be linked to Guest Pass Setting and each workstation is linked with a Location. The Guest Pass System shall be installed and operated at any location where Schlage Security Management System is running.

2. Default Location - The system shall provide a factory set location and it cannot be edited or deleted. Default location shall be used if you want to view the guest's information at every location. The default shall be a global location.
3. To define additional locations, the system shall require hardware dongle (software license key). The dongle shall be used only on the PC where database server resides. No dongles shall be required at any workstations.
4. The Guest Pass System shall only allow the operator to select from Guest Locations that the dongle (license key) allows them to see. If the dongle has a guest location count of 5, only 5 guest locations will display; no matter how many are actually defined. The count does not include the default location.

G. Pending Guest Records: The system shall provide a way to create pending guest record. The guests who are not signed into the system (the guests who don't have access control permissions) shall be added to this list. The guest who is signed out from the system, but expected to come back at a later time also shall also be added to this list.

1. Guest Sign-In - The system shall create a list of authorized and expected guests for each day. The information in this list shall indicate:
2. The identity of the guest.
3. The identity of the person who requested the visit (the host).
4. The responsible person authorizing the visit (an employee with authorizing permissions).
5. Authorized time limits of the visit.
6. Initial information (filled in by the requestor) about the Guest including name, affiliation, purposes of visit, escort/unescorted, access control badge or no access control badge. This information shall be easily transferred or stored in further definition of the Guest record by the operator.
7. Visit Extension - The system shall provide the ability to extend a specific Guest's timeframe. If the person making the request is authorized or is the original authorizer, the operator shall click the guest's record and execute the function to extend the record. The choice will be by days or hours. The system shall automatically record the date and time of the extension. The access records of the guest shall be automatically extended by the specified amount of time.
8. License Field Cross Reference -The system shall allow the user to map the fields on a driver's license to the existing cardholder fields. First Name, Last Name, and Initial shall be automatically mapped fields and shall not be changed by the user. The user shall be able to create user-defined fields to match with the driver's license fields and retrieve information by scanning the guest's driver's license.
9. Signing Out - The system shall provide for several methods of signing the Guest out of the facility, including:
10. Once the record is marked as Signed Out, all access privileges assigned to the Guest and to their badge shall be removed so that additional usage shall be denied.
11. If an access control badge is assigned, but is lost during the Guest's visit, the operator shall be able to find the Guest record by typing in the name of the Guest. Once the record is retrieved, the operator shall mark it as Signed Out. All access privileges shall be blocked and the operator shall record the fact that the badge were lost and was not returned.

12. The system shall provide the optional recording of a digital photograph of the Guest as they signed in or out of the facility. This photograph shall be saved with the guest record and shall be used for verification purposes as well as comparison and reporting.
13. The system shall be equipped with a Search feature, to access the signed out records easily.

H. Access Control Templates: The system shall provide a quick and easy way to assign area access rights to guests. This shall be implemented via the use of access control templates. Each template shall contain conventional description and notes fields. Then the user shall be able to select either the hours after sign-in option or the time of sign-in day option.
1. If the hours after sign in option is selected, then the guest shall be expired after the number of hours specified after they were signed in. If the time of sign-in day option is selected, the guest's access rights shall be expired at the specified time of the sign-in day. The user shall also be able to specify the area sets the guest access template will use. The user shall be able to select as many area sets as needed.
2. After these templates are defined, the Guest Pass operator shall select them to make authorization much simpler. The operator shall only need to select one record instead of defining access time and area sets.
3. Automatic Guest Sign-in and Sign-Out - The system shall allow the user to define specific readers as sign-in and sign out readers. This shall allow a pending guest signed into the system with a single card swipe and an existing guest signed-out of the system in the same way.

I. Guest Pass Web Interface: The system shall offer a browser-based web interface to allow an employee to request that a guest be permitted to enter a facility.
1. The web page shall contain a form where the user can enter required information to add a new guest. Once the user submits this information, a new pending guest record shall be created in the system (Guest Pass client). The administrators may use the Guest Pass System to view this information and make appropriate changes.
2. The web interface shall be a simple form, displaying empty fields required to register a guest. The required fields shall be marked with a * sign.
3. The form shall not be submitted, until all the required information has been entered. Once the required information is entered and the form is submitted, the guests added shall be displayed in the pending guests tab in the Guest Pass Client after the views are dynamically refreshed.
4. This form shall be available on authorized client workstations and can be submitted in several ways.
5. The form will be available via an HTML page on the company's intranet or via the Internet and can be submitted via HTML.
6. The form can be opened, completed, and submitted via e-mail.
7. The form may be printed and handed to an authorizing person for signature or approval before final submission to the Guest Pass system.

J. Web Page Security: The web page shall be secured using Windows 2000 security. The web directory where the Guest Pass Active Server Pages (ASP) will be located shall be secured to

specific NT users, giving limited access to the page and to its functionality. There shall be NO login or verification once the user has access to the web pages.

1. Simple Setup for Multiple Databases - The Guest Pass Web Page shall easily be setup to connect to any Schlage Security Management System Database existing on the network. As long as the IIS server has access to the SQL Server database, the Web Page shall be posted to it.
2. Report Generation
3. The system software shall be able to generate reports of Alarm History, Archive History, Audit Trail, Cardholder Transactions, Guest Pass History and Transaction History Reports. The user may print and/or export these reports to other applications, store to disk or send to mail recipients, as well.
4. The system shall provide 53 predefined reports making for a simple and efficient end user experience. There shall be a menu presented to the person requesting the report, prompting him/her to enter the parameters necessary to retrieve the desired information (i.e. date, time, location(s), type(s) of alarms etc.)
5. The user shall also be able to derive 73 pre-defined sub reports by defining their own criteria. This type of reports shall require selections to be entered that define the user created sub report. Some examples of criteria may be cardholders by category, transactions in a particular area etc.
6. The system shall also allow the end user to create custom defined reports with variable selection, using a third party application like crystal reports.
7. When requesting a report, the user shall be able to view a "screen preview" of the alarm activity before directing the report to a printer. For cases when the same report is run repeatedly, the user shall have the ability to "save" the report parameters and format so that it is not necessary to reenter the parameters.
8. The reports may be secured using operator login id and password.

K. Scheduled Reports: The system shall allow the user to create pre-defined reports on a scheduled basis. The system shall provide the user with a wizard that guides him/her through the process of selecting a report, creating a schedule and assigning a printer. The user shall be able to generate the reports and print them on a weekly or daily basis at a specific time period. Any report that is created in the system shall be assigned a schedule.

L. The system shall allow the user to store e-mail addresses of recipients of reports and send transaction history reports periodically.

M. System Wide Features:

1. Context Sensitive Help: System shall provide context sensitive help for all the modules. It shall be accessed from Help>Contents and Index. The help for a specific module shall be accessed by clicking F1 from the specific module.
2. Wizards - The software shall provide step-by-step wizards for easy programming of the entire system.
3. Pull down Menus - The system programming shall be menu driven and include tool bar icon for all major options in the menu.

4. Onscreen help - The software shall provide onscreen description of all the actions that the user has to perform while programming the system.
5. Search and Advanced Find - The system shall include a simple search feature for the user to easily find data in the database. The system shall also provide functionality that helps the user to further customize the search criteria and make the search more precise. The user shall be able to use Boolean logic to run highly precise and more complex searches. The system shall also be capable of saving the search criteria that the user defines.
6. Right Click Options: The system shall provide right click options for most of the system functionalities.

2.8 Floor Select Elevator Control

A. Elevator access control shall be integral to security access.
1. The system shall be able to control an unlimited number of elevators and each elevator may have an unlimited number of floors. The elevator reader interface shall be connected to the same field panel as the digital inputs and digital outputs used to control the elevator cab. There shall be no limit to the number of elevator cabs that can be controlled via the system host software.
2. System shall be capable of providing full elevator security and control through dedicated Controllers without relying on the control-station host PC for elevator control decisions.
3. Access-control system shall enable and disable car calls on each floor and floor select buttons in each elevator car, restricting passengers' access to the floors where they have been given access.
4. System setup shall, through programming, automatically secure and unsecure each floor select button of a car individually by time and day. Each floor select button within a car shall be separately controlled so that some floors may be secure while others remain unsecure.
5. When a floor select button is secure, it shall require the passenger to use his/her access code and have access to that floor before the floor select button will operate. The passenger's credential shall determine which car call and floor select buttons are to be enabled, restricting access to floors unless authorized by system's access code database. Floor select button shall be enabled only in the car where the credential holder is the passenger.

B. Security access system shall record which call button is pressed, along with credential and time information.
1. System Controller shall record elevator access data.
2. The Controller shall reset all additional call buttons that may have been enabled by the user's credential.
3. The floor select elevator control shall allow for manual override either individually by floor or by cab as a group from a workstation PC.

2.9 Security Tour System

A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.
   1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.
   2. Guard tour activity shall be automatically logged to the central-station PC's hard drive.
   3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the Central Station to indicate the time and station.
   4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.
   5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check-in" alarm occur.

B. Guard tour module shall allow proprietary direct-connected systems to use security access-control hardware to perform guard tour management in real time.

C. System shall be a Windows Client application that shall allow definition of tours, real-time tracking of running tour progress, alerts when tour criteria is not satisfied, and historical reporting of previously run tours. System shall have two modules; the Security Tour Editor and the Security Tour Client. The administrator shall have the ability to define as many tours as required using the Security Tour Editor module.
   1. System shall be responsible for holding all running tours in memory. It shall provide a status of all running tours upon request and monitor tour activity by communicating with the System Processor for transactions.
   2. Additionally, the Security Tour Service shall allow the addition of new running tours, pausing, resuming, and stopping of currently running tours.

D. Guard tour and other system features shall operate simultaneously with no interference.

E. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at same time.

2.10 Video and Camera Control

A. Control station or designated workstation displays live video from a CCTV source.
   1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
   2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.

3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.

B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.

C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

PART 3 - EXECUTION

3.1 Examination

A. Site Verification of Conditions
1. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
2. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

A. Furnish any inserts required for building into concrete, masonry, and other work, to support and attach work of this section. Furnish in ample time to comply with schedule of work into which inserts are built.

B. Verify that power and outlets are in correct locations.

C. Verify that building structure is properly prepared for mounting, attachment and support of equipment.

D. Prior to installation of systems components and devices, verify all required preparations have been properly performed and that substrates are acceptable for installation.
1. Verify all rough-ins and field dimensions.

E. Report in writing to the Architect any prevailing conditions that will adversely affect satisfactory execution of Work in this Section.

1. Security Consultant reserves the right to review proposed methods of construction/installation, reject proposed methods, and have the installation done in a satisfactory method at the Contractor's cost.

3.3 Installation, General

A. Install work in accordance with manufacturer's recommendations, instructions and final Shop Drawings.

B. Anchor components securely in place, plumb, level, and accurately aligned. Provide separators and isolators to prevent corrosion and electrolytic deterioration.

C. For card readers that are located in equipment traffic areas, and that are exposed to damage due to collision or impact from forklifts, or manually moved carts, carriers, or other equipment used by the Owner, provide protective bollards, railings, coverings etc. to ensure that all card readers installed are properly protected from such damage.

D. Provide fastenings, plates, and other incidental items required for complete and operational installation.

E. Provide required electrical work in accordance with code requirements.

3.4 Wiring

A. General: Comply with provisions of Section 28 05 13 – Conductors and Cables for Electronic Safety and Security.

B. Install all wiring connecting all system components and controlled and monitored devices.

C. Install all transformers, relays and other accessories.

D. Install all cable, and perform all cable splicing and equipment terminations.

E. Use 45-degree condolettes to enclose and protect cabling from door contacts/switches. Condolettes shall be placed as close to the contact/switch as possible.

F. Pull continuously between connections where possible.

G. Install electronic systems wiring and cabling in conduit or raceway, as noted on Drawings and as specified in Section 28 05 28.

H. Pulling cables and wires:
1. Do not force or pressure in a manner, which will stretch, break or damage jacket.
2. Use an inert anti-friction material to assist in pulling wire.

3. Pull all cables and wires to be installed in a raceway all at one time.

3.5 Grounding

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:
1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.6 Identification

A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA-606.

B. Using cable and asset management software specified in Part 2, develop Cable Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement.

C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

D. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
1. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

3.7 System Software

A. Existing software: currently Genetec Version 5.11 (or latest version)

3.8 System Programming

A. The Contractor shall work with the Owner to ensure that the new components will be properly programmed into the existing system.

3.9 Site Quality Control

A. The Contractor shall develop a Final Test and Acceptance (FTA) Plan. The plan shall identify each new system component provided in the work, intent of test, method or methods of test and expected results. Each component listed in the plan shall include space for test part signatures, brief comments, time of test and pass/fail check boxes. The FTA plan shall be submitted to the owner's representative 30 days prior to the scheduled final test.

B. Provide manufacturer's supervision of final testing of each system.
   1. On-Site Testing: Manufacturer trained and authorized Systems Integrator shall functionally test each component in the system after installation to verify proper operation and confirm that the wiring and dressing conform to the wiring documentation.

C. Each system shall test free from interference, opens, grounds, and short circuits.

3.10 Start-Up Test (burn-in)

A. Following completion of the Final Test, the system shall undergo a thirty (30) day Operational Demonstration Test (ODT) or Burn-In period. This operational demonstration period shall start when all specified systems and equipment have been installed and "Substantial Completion" is reached, with only a moderate number of punch list items remaining.

B. During this period, the system shall be operated under a normal facility traffic load for no less than 30 days. If any item or system fails during the ODT, the 30-day burn-in period shall be suspended for that item until repaired or replaced. Once repaired or replaced, the burn-in period shall recommence.

C. Final system acceptance of the entire project will be withheld until after successful completion of this operational demonstration period for all systems and components.

D. System will not be considered substantially complete until the following activities have been successfully completed:
   1. Acceptance of all submittals.
   2. Delivery of final documentation.
   3. Successful Final Test and Inspection
   4. Successful Operational Demonstration Test
   5. Successful training and demonstration, including operation of systems using the manuals.
   6. Purging of Contractor User privileges and return of all key card media.

3.11 Cleaning and Waste Management

A. Cleaning and Touchup: Immediately after installation, including the completion of wiring and testing, clean all work and touchup all damaged factory finishes.

3.12 Protection

1. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.
2. Protection: Provide protective covers, fenders, and barriers as necessary to maintain Work of this Section in same condition as installed until time of Substantial Completion.

3.13 Closeout Activities

A. Demonstration

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. Refer to Division 01 Section "Demonstration and Training"
2. Develop separate training modules for the following:
   a. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
   b. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
   c. Security personnel.
   d. Hardware maintenance personnel.
   e. Corporate management.

B. Training

1. Operator Training: Instruct operating staff in proper operation, including hands-on training.
   a. Minimum of twenty-four (24) man-hours covering the operations for each system installed.
   b. Training sessions shall be provided to supervisors, staff, maintenance personnel and any other personnel designated by the Owner. Contractor should prepare to provide operator training for up to ten (10) personnel.
   c. Contractor shall be prepared to provide training sessions on all work shifts, including day, evening and night shifts.
2. Refresher Training: Provide a 90-day Refresher Training Session to operators.
   a. Minimum of eight (8) hours of training for each owner-designated session.
   b. Training shall cover summaries of all operator and administrator training topics and shall include greater detail on subject areas or operations not yet mastered by operators or administrators.

3. Review in detail all information in the Operations and Maintenance Manuals for each system provided.
4. Prior to administering the above training, the Contractor(s) shall prepare an outline of the training, identifying the goals and expectations of the course and detailing what students are expected to learn.
5. Training courses shall be videotaped, at Owner's request, for subsequent training use by the Owner.

3.14 Life Cycle Activities

A. Commissioning: All system components shall be commissioned as to conform to the manufacturer's recommendations for maximum life cycle.

B. Operation and Use: Provide, in writing, Operation and Use procedures for each system component. Such procedures shall be written in order to conform to the manufacturer's recommendations for maximum life cycle.

C. Maintenance: Provide, in writing, Maintenance procedures for each system component. Such procedures shall be written in order to conform to the manufacturer's recommendations for maximum life cycle.

3.15 Installation

A. Provide, install and wire all Reader Controllers (as required), Access Control Main Panels (Minimum 1 per floor) complete with power supplies for sufficient power to power all AD300 series Access Control Locks being provided in specification section 08 71 00 Finish Hardware.

B. Furnish, install and wire all Access Controlled openings as to provide a complete and functional Access Control System to match the existing system being used by Alamo Colleges.

C. Access Control installer shall coordinate and reference all affected specification sections to insure a complete and functional Access Control System.

D. Provide and install all required RS485 Communication/Power cabling required.

E. Materials supplied and installed as part of this specification sections are as follows:
1. Card Readers MT-15 wall mounted. Mullion mounted readers are acceptable depending on existing conditions. Exterior doors only.
2. Electrified Card Reader Locks (Hard Wired) AD300-CY-70-MT-RHO-JD and Electrified Panic Exit Device Trim AD300-993-70-MT-RHO-JD. Interior use only.
3. Reader Interface Boards VRINX
4. Reader Controllers VRCNX-M
5. Power Supplies PS906-900BBK-900FA and/or as required by the system size.

6. Proximity & Smart Cards (10) per reader or as required by Alamo Colleges.

END OF SECTION 28 13 00

SECTION 28 31 11 – DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - General

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section:

1.2 Summary

A. Section Includes:
1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Nonsystem smoke detectors.
6. Heat detectors.
7. Notification appliances.
8. Device guards.
9. Firefighters' two-way telephone communication service.
10. Firefighters' smoke-control station.
11. Magnetic door holders.
12. Remote annunciator.
13. Graphic annunciator.
14. Addressable interface device.
15. Digital alarm communicator transmitter.
16. Radio alarm transmitter.
17. Network communications.
18. System printer.

B. Related Requirements:
1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.3 Definitions

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 Action Submittals

A. Product Data: For each type of product, including furnished options and accessories.
1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.

13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified, fire-alarm technician; Level III minimum.
   c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 Informational Submittals

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 Closeout Submittals

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
      a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
      b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
      d. Riser diagram.
      e. Device addresses.
      f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
      g. Record copy of site-specific software.
      h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
         1) Equipment tested.
         2) Frequency of testing of installed components.
         3) Frequency of inspection of installed components.
         4) Requirements and recommendations related to results of maintenance.
         5) Manufacturer's user training manuals.
      i. Manufacturer's required maintenance related to system warranty requirements.
      j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.8 Maintenance Material Submittals

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.9 Quality Assurance

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.10 Project Conditions

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
   1. Notify owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
   2. Do not proceed with interruption of fire-alarm service without owner's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 Sequencing and Scheduling

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.12 Warranty

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
   1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - Products

2.1 System Description

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. 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.

2.2 Systems Operational Description

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   1. Manual stations.
   2. Heat detectors.
   3. Flame detectors.

4. Smoke detectors.
5. Duct smoke detectors.
6. Air-sampling smoke-detection system (VESDA).
7. Carbon monoxide detectors.
8. Combustible gas detectors.
9. Automatic sprinkler system water flow.
10. Preaction system.
11. Fire-extinguishing system operation.
12. Fire standpipe system.
13. Dry system pressure flow switch.
14. Fire pump running.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Activate preaction system.
12. Recall elevators to primary or alternate recall floors.
13. Activate elevator power shunt trip.
14. Activate emergency lighting control.
15. Activate emergency shutoffs for gas and fuel supplies.
16. Record events in the system memory.
17. Record events by the system printer.
18. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Elevator shunt-trip supervision.
5. Fire pump running.
6. Fire-pump loss of power.
7. Fire-pump power phase reversal.
8. Independent fire-detection and -suppression systems.
9. User disabling of zones or individual devices.

10. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:
1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 Performance Requirements

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.4 Fire Alarm Control Unit

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
   a. *Basis of Design is JCI Simplex 4100-es. (District Standard). No Substitutions without prior written consent from ACD*
   b. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.

c. Include a real-time clock for time annotation of events on the event recorder and printer.
d. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
e. The FACP shall be listed for connection to a central-station signaling system service.
f. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class A, Class B, Class C, Class D, Class E.
2. Pathway Survivability: Level 1.
3. Serial Interfaces:
a. One dedicated RS 485 port for central-station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.
d. One RS 232 port for VESDA HLI connection.
e. One RS 232 port for voice evacuation interface.

D. Stairwell and Elevator Shaft Pressurization: Provide an output signal using an addressable relay to start the stairwell and elevator shaft pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
1. Pressurization starts when any alarm is received at fire-alarm control unit.
2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

E. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.

2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520- Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.
2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

H. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

K. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
b. Programmable tone and message sequence selection.
c. Standard digitally recorded messages for "Evacuation" and "All Clear."
d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

L. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

N. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 Preaction System
1. Initiate Presignal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a preaction system shall be annunciated at the FACP only, without activation of the general evacuation alarm.

2.6 Manual Fire-Alarm Boxes

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
   2. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
   3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.7 System Smoke Detectors

A. General Requirements for System Smoke Detectors:
   1. Comply with UL 268; operating at 24-V dc, nominal.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
   3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
   6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
      a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
      b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
      c. Multiple levels of detection sensitivity for each sensor.
      d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.8 Projected Beam Smoke Detectors

A. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.

B. Detector Address: Accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.

C. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present average value.
4. Present sensitivity selected.
5. Sensor range (normal, dirty, etc.).

2.9 Carbon Monoxide Detectors

A. General: Carbon monoxide detector listed for connection to fire-alarm system.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Testable by introducing test carbon monoxide into the sensing cell.
   3. Detector shall provide alarm contacts and trouble contacts.
   4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
   5. Comply with UL 2075.
   6. Locate, mount, and wire according to manufacturer's written instructions.
   7. Provide means for addressable connection to fire-alarm system.
   8. Test button simulates an alarm condition.

2.10 Multicriteria Detectors

A. Mounting: Twist-lock base interchangeable with smoke-detector bases.

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   1. Primary status.
   2. Device type.
   3. Present sensitivity selected.
   4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.
   1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
   2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
   3. Heat sensor shall be as described in "Heat Detectors" Article.

4. Each sensor shall be separately listed according to requirements for its detector type.

2.11 Nonsystem Smoke Detectors

A. General Requirements for Nonsystem Smoke Detectors:
1. Nonsystem smoke detectors shall be listed as compatible with the fire-alarm equipment installed or shall have a contact closure interface listed for the connected load.
2. Nonsystem smoke detectors shall meet the monitoring for integrity requirements in NFPA 72.

B. Single-Station Smoke Detectors:
1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping- sound device.
2. Auxiliary Relays: One Form C, rated at 0.5 A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
4. Visible Notification Appliance: 177-cd strobe.
5. Heat sensor, 135 deg F combination rate-of-rise and fixed temperature.
6. Test Switch: Push to test; simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug- in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type, indicating detector has operate and power-on status.

C. Single-Station Duct Smoke Detectors:
1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
   a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot when tested according to UL 268A.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
   a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; listed for use with the supplied detector.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.12 Heat Detectors

A. General Requirements for Heat Detectors: Comply with UL 521.
   1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 135 deg F.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Continuous Linear Heat-Detector System:
   1. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
   2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
   3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
   4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.13 Air-Sampling Smoke Detector

A. General Description:
   1. Air-sampling smoke detector shall be laser based using a piping system and a fan to transport the particles of combustion to the detector.
   2. Provide two levels of alarm from each zone covered by the detector and two supervisory levels of alarm from each detector.
   3. The air being sampled shall pass through filters to remove dust particulates greater than 20 microns before entering the detection chamber.
   4. Detectors shall have the capability via RS 485 to connect up to 100 detectors in a network.
   5. Detectors shall communicate with the fire-alarm control unit via addressable, monitored dry contact closures, RS 485, and interface modules. Provide a minimum of six relays, individually programmable remotely for any function.

6. Pipe airflow balancing calculations shall be performed using approved calculation software.

B. Detector:
1. Detector, Filter, Aspirator, and Relays: Housed in a mounting box and arranged in such a way that air is drawn from the detection area and a sample passed through the dual-stage filter and detector by the aspirator.
2. Obscuration Sensitivity Range: 0.005 - 6 percent obs/ft.
3. Four independent, field-programmable, smoke-alarm thresholds per sensor pipe and a programmable scan time delay. The threshold set points shall be programmable.
    a. The four alarm thresholds may be used as follows:
        1) Alarm Level 1 (Alert): Activate a visual and an audible supervisory alarm.
        2) Alarm Level 2 (Action): Activate shutdown of electrical/HVAC equipment and activate a visual and an audible supervisory alarm.
        3) Alarm Level 3 (Fire 1): Activate building alarm systems and initiate call to fire response unit.
        4) Alarm Level 4 (Fire 2): Activate suppression system or other countermeasures.
    b. Final Detection System Settings: Approved by owner.
    c. Initial Detection Alarm Settings:
        1) Alarm Level 1 (Alert): 0.08 percent obs/ft.
        2) Alarm Level 2 (Action): 1.0 percent obs/ft.
        3) Alarm Level 3 (Fire 1): 2.0 percent obs/ft.
        4) Alarm Level 4 (Fire 2): 4.0 percent obs/ft.
4. Power Supply:
    a. Regulated 24-V dc, monitored by the fire-alarm control unit, with battery backup.
    b. Battery backup shall provide 24 hours' standby, followed by 30 minutes at maximum connected load.
5. Detector shall also transmit the following faults:
    a. Detector.
    b. Airflow.
    c. Filter.
    d. System.
    e. Zone.
    f. Network.
    g. Power.
6. Provide four in-line sample pipe inlets that shall contain a flow sensor for each pipe inlet. The detector shall be capable of identifying the pipe from which smoke was detected.
7. Aspirator: Air pump capable of allowing for multiple sampling pipe runs up to 650 feet in total, (four pipe runs per detector) with a transport time of less than 120 seconds from the farthest sample port.
8. Air-Sampling Flow Rates Outside Manufacturer's Specified Range: Result in a trouble alarm.
9. Provide software-programmable relays rated at 2 A at 30-V dc for alarm and fault conditions.

10. Provide built-in event and smoke logging; store smoke levels, alarm conditions, operator actions, and faults with date and time of each event. Each detector (zone) shall be capable of storing up to 18,000 events.
11. Urgent and Minor Faults. Minor faults shall be designated as trouble alarms. Urgent faults, which indicate the unit may not be able to detect smoke, shall be designated as supervisory alarms.

C. Displays:
1. Include display module within each detector.
2. Each display shall provide the following features at a minimum:
   a. A bar-graph display.
   b. Four independent, high-intensity alarm indicators (Alert, Action, Fire 1, and Fire 2), corresponding to the four alarm thresholds of the indicated sector.
   c. Alarm threshold indicators for Alert, Action, and Fire 1.
   d. LED indication that the first alarm sector is established.
   e. Detector fault and airflow fault indicators.
   f. LED indicators shall be provided for faults originating in the particular zone (Zone Fault), faults produced by the overall smoke-detection system, and faults resulting from network wiring errors (Network Fault).
   g. Minor and urgent LED fault indicators.

D. Sampling Tubes:
1. Smooth bore with a nominal 1-inch OD and a 7/8-inch ID. Sampling pipe with between 5/8- and 1-inch ID can be used in specifically approved locations when recommended by manufacturer.
2. Pipe Material: CPVC and complying with UL 1887, "Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics."
3. Joints in the sampling pipe shall be airtight. Use solvent cement approved by the pipe manufacturer on all joints except at entry to the detector.
4. Identify piping with labels reading: "Aspirating Smoke Detector Pipe - Do Not Paint or Disturb" along its entire length at regular intervals according to NFPA 72.
5. Support pipes at not more than 60-inch centers.
6. Fit end of each trunk or branch pipe with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

E. Sampling Holes:
1. Sampling holes of 5/64 inch, or other sized holes per manufacturer's written instructions, shall be separated by not more than the maximum distance allowable for conventional smoke detectors. Intervals may vary according to calculations.
2. Follow manufacturer's written recommendations to determine the number and spacing of sampling points and the distance from sampling points to ceiling or roof structure and to forced ventilation systems.
3. Each sampling point shall be identified by an applied decal.

2.14 Notification Appliances

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory finished, red.

F. Voice/Tone Notification Appliances:
   1. Comply with UL 1480.
   2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
   3. High-Range Units: Rated 2 to 15 W.
   4. Low-Range Units: Rated 1 to 2 W.
   5. Mounting: Flush, semirecessed or surface mounted and bidirectional.
   6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

G. Exit Marking Audible Notification Appliance:
   1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
   2. Provide exit marking audible notification appliances at the entrance to all building exits.
   3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.15 Firefighters' Two-Way Telephone Communication Service

A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
   1. Common-talk type for firefighter use only.
   2. Selective-talk type for use by firefighters and fire wardens.
   3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously. An indicator lamp shall flash if a phone is disconnected from the talk circuits.
   4. Addressable firefighters' phone modules to monitor and control a loop of firefighter phones. Module shall be capable of differentiating between normal, off-hook, and trouble conditions.
   5. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is taken off the hook, it causes an audible signal to sound and a high-intensity lamp to flash at the fire- alarm control unit.
   6. Selector panel controls to provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
   7. Display: Digital to indicate location of caller.
   8. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory- standard red finish, with handset.
      a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Emergency Phone."
      b. With "break-glass" type door access lock.
   9. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Emergency Phone."
   10. Handsets: push-to-talk-type set with noise-canceling microphone stored in a cabinet adjacent to fire-alarm control unit.

2.16 Firefighters; Smoke Control System

A. Initiate Smoke-Management Sequence of Operation:
   1. Comply with sequence of operation as described in Section 230993.11 "Sequence of Operations for HVAC DDC."
   2. Fire-alarm system shall provide all interfaces and control points required to properly activate smoke-management systems.
   3. First fire-alarm system initiating device to go into alarm condition shall activate the smoke-control functions.
   4. Subsequent devices going into alarm condition shall have no effect on the smoke-control mode.

B. Addressable Relay Modules:

1. Provide address-setting means on the module. Store an internal identifying code for control panel use to identify the module type.
2. Allow the control panel to switch the relay contacts on command.
3. Have a minimum of two normally open and two normally closed contacts available for field wiring.
4. Listed for controlling HVAC fan motor controllers.

2.17 Magnetic Door Holders

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.18 Graphic Annunciator

A. Graphic Annunciator Panel: Mounted in an aluminum frame with non-glare, minimum 3/16-inch thick, clear acrylic cover over graphic representation of the facility. Detector locations shall be represented by red LED lamps. Normal system operation shall be indicated by a lighted, green LED. Trouble and supervisory alarms shall be represented by an amber LED.
   1. Comply with UL 864.
   2. Operating voltage shall be 24-V dc provided by a local 24-V power supply provided with the annunciator.
   3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and a lamp test switch.
   4. Semi-flush mounted in a NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
   5. Graphic representation of the facility shall be a CAD drawing and each detector shall be represented by an LED in its actual location. CAD drawing shall be at 1/8-inch per foot scale or larger.
   6. The LED representing a detector shall flash two times per second while detector is an alarm.

B. Graphic Annunciator Workstation: PC-based, with fire-alarm annunciator software with historical logging, report generation, and a graphic interface showing all alarm points in the system. PC with operating system software, hard drive, digital display monitor, with wireless keyboard and mouse.

2.19 Remote Annunciator

1. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
2. Mounting: Flush cabinet, NEMA 250, Type 1.
3. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.20 Addressable Interface Device

A. General:
1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.
1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.21 Digital Alarm Communicator Transmitter

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
1. Verification that both telephone lines are available.

2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.22 Radio Alarm Transmitter

A. Transmitter shall comply with NFPA 1221 and 47 CFR 90.

B. Description: Manufacturer's standard commercial product; factory assembled, wired, and tested; ready for installation and operation.
1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
3. Normal Power Input: 120-V ac.
4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph with a gust factor of 1.3 without failure.
6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
7. Antenna-Cable Connectors: Weatherproof.
8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.

C. Functional Performance: Unit shall receive alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
   1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
   2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
   3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
   4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
   5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
   6. Local Fire-Alarm-System, Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

2.23 Network Communications

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet or Modbus for connection to building automation system.

2.24 System Printer

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.25 Device Guards

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

PART 3 - Execution

3.1 Examination

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
   2. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Equipment Installation

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   1. Connect new equipment to existing control panel in existing part of the building.
   2. Connect new equipment to existing monitoring equipment at the supervising station.
   3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Equipment Mounting: Install fire-alarm control unit on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
   1. Install seismic bracing. Comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems."
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Equipment Mounting: Install fire-alarm control unit on finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

F. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
   2. Mount manual fire-alarm box on a background of a contrasting color.
   3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

G. Smoke- or Heat-Detector Spacing:
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

H. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

I. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

J. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.

K. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

L. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

M. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

N. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

O. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

P. Device Location-Indicating Lights: Locate in public space near the device they monitor.

Q. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph wind load with a gust factor of 1.3 without damage.

3.3 Pathways

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 Connections

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke- control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems.
   4. Magnetically held-open doors.
   5. Electronically locked doors and access gates.

6. Alarm-initiating connection to elevator recall system and components.
7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.

3.5 Identification

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 Grounding

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 Field Quality Control

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Visual Inspection: Conduct visual inspection prior to testing.
a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 Maintenance Service

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 Software Service Agreement

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 Demonstration

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11

Division 31 – Earthwork

31 00 00	Earthwork
31 23 00	Earth Moving
31 63 29	Drilled Concrete Pierce and Shafts

Division 31 – Earthwork

SECTION 31 00 00 – EARTHWORK

PART 1 - General

1.1 Scope of Standards

A. This standard provides general guidance concerning the specific preferences of Alamo Community College District for site grading

1.2 General Requirements

A. Tree Affidavit/Permit Application Landscape Plan

B. Tree Preservation Plan Floodplain Development Permit

C. Stormwater Pollution Prevention Plan (SWP3)& Permit

D. Edwards Aquifer Contributing/Transition Zone Plan & Permit

E. Historic Review

F. Archeological Review Endangered Species Review

G. Texas Department of Licensing and Regulation, Elimination of Architectural Barriers Act (Texas Accessibility Standard)

H. Americans with Disabilities Act

I. Interlocal Agreement

J. Review copies of any available geotechnical reports and obtain a geotechnical report for new projects

PART 2 - Products

2.1 Materials

A. Import fill shall meet ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups free of rock or gravel larger than 3 inches in any dimension, debris, waste, vegetation, and other deleterious matter.

B. SWP3 items shall conform to Texas Department of Transportation specifications.

C. Conform to geotechnical report for allowable materials.

PART 3 - Execution

3.1 The finished floor elevation of the building should be raised sufficiently to permit positive drainage away from the building and to avoid pocketing of water behind sidewalks or against foundation walls. The grade at 12' to 15' from the building shall be 1' below the finished floor elevation. A 2% slope in sidewalks from all entrances is mandatory.

3.2 The nearest swale shall not be closer than 15' to the building and its' highest point shall be 1' lower than the inside main floor of the building.

3.3 Irrigation systems shall not direct water towards the building. All piping passing in or out of the building shall be designed to allow for movement of the building.

3.4 Consideration should be given to protect sidewalks and asphalt parking areas against the effects of heaving soil. Engineers should be sensitive and cautious in these areas and make recommendations which in their judgment would be in the best interest of the Owner.

3.5 In severe conditions the following precautions are acceptable when recommended by the Geotechnical engineer.

3.6 Sub-surface peripheral drainage systems to control underground water. Geotechnical Engineer should assist in specifying subsurface drainage systems.

3.7 Concrete aprons adjacent to foundation walls.

3.8 Appropriate details shall be used to prevent trapping water behind sidewalks or in planters adjacent to a building. Splash blocks or pipes should conduct water to a distance at least 6' to 8' from the building. A continuous slope away from the building shall be used. Area surface drains, trench drains or similar methods should be used to avoid ponding water any length of time.

3.9 Sidewalks shall not be used for drainage ways.

3.10 Provide existing and finish contours of entire site to include 10' beyond property lines and to the centerline of adjacent roads.

3.11 Provide spot elevations at sidewalks, building entrances, parking lot corners, and all exterior concrete slabs, including the storage building.

3.12 Provide an underground drainage system for courtyard areas.

3.13 Provide tops and invert elevations of storm drainage structures, such as catch basins and culverts, to which the property drains.

3.14 Check slope on paving surfaces. Provide 2% minimum slope for asphalt surfaces and 1% minimum slope on concrete surfaces. Where these slopes cannot be maintained, coordination should occur with ACCD. The maximum slope should not exceed 5%. All accessible routes shall meet the current ADA/TAS requirements.

3.15 Lawn area shall have a 2% minimum slope and a desirable maximum of 25%. Ditches and swales shall have a minimum slope of 0.5%.

3.16 Survey Control

A. Types of Control

1. Primary Control - Permanent in nature. It is to be used to disseminate Secondary Control for use by anyone who may need to submit or to use the data base. It is permanent in nature. Warrants recovery and replacement procedures to insure the integrity of the data.
2. Secondary Control - Usually project specific. Not necessarily permanent in nature; it must be available and be maintained for the time length of the project. It must be derived from and closely tied to Primary Control.
3. The Consensus for the Datum source is:
   a. Vertical NAVD 1988
   b. Horizontal NAD 1983 (State Plane Coordinates) (So. Central Zone)
   c. Unit US survey feet
4. Uses for the Control
   a. Control Aerial Topography
   b. Control Conventional Topography Effort (Field Survey Work)
   c. Control Construction Activity
   d. Provide a Common Datum Source for Design Efforts
5. Accuracy Requirements

a. Horizontal and vertical accuracy should meet or exceed those described in the Manual of Practice for Land Surveying in Texas. This manual is comprised of Standards for Land Surveys and Specifications for Categories of Surveying.
b. Data derived from the use of GPS equipment should comply to the Federal Geodetic Control Committee Standards for Condition C 1. These Standards are the industry accepted method for insuring data integrity for GPS derived data.
c. Design the network for the more stringent use accuracy Requirements.
d. Design the network only for the purpose of this project's needs.
e. The Control network should be designed site specific. The locatio n, spacing and placement of the network should be selected based on long term development plans.

6. Available Control Networks
   a. CSA
   b. SAWS
   c. TxDOT
   d. SARA
   e. USC&G
7. A surveyor should provide at least 2 secondary control points with both horizontal and vertical control for each project. These control points should be identified on all site plans. The surveyor shall provide a topographic survey, improvement, utility and tree survey for each project. The inverts of all sanitary sewers and storm sewers in the vicinity of the project shall also be located.
8. A tree survey should be prepared in accordance with the City of San Antonio Tree Ordinance. The tree survey should include location, size and species. The tree survey should be field verified by the Landscape Architect.

3.17 Steps to Approval and Compliance With Storm Water Requirements

A. Engineer to develop sediment and erosion controls for the site.

B. Engineer to develop storm water management measures including a Storm Water Pollution Prevention Plan (SWP3) and submit with plat application or building permit application. Make the SWP3 available to SAWS personnel during site inspections.

C. Contractor to file a Notice of Intent (NOI) or Construction Site Notice (CSN) with TCEQ, at least 48 hours prior to starting any approved construction activity and at least 48 hours prior to a new individual taking over as the site 'operator'. Send copy of NOI to SAWS.

D. Contractor to install appropriate best management practices (BMPs) correctly and in a timely manner.

E. Contractor to perform inspections biweekly and after a 1/2" rain event. Contractor to maintain BMPs in good working order and keep the SWP3 plan current.

F. Contractor to file a Notice of Terminatin (NOT) and remove controls when the project meets the TPDES definition of "final stabilization" or is totally completed.

3.18 Submittal Requirements for Storm Water Pollution Prevention Plan (SWP3)

A. Site Information
1. Existing soil conditions and runoff water quality
2. Location of existing waters on the construction site
3. Information on Endangered Species on the site
4. Name of the receiving waters
5. Latitude and Longitude coordinates

B. Site Plan Contents
1. Description of the construction activity.
2. Description of the intended sequence of events for major activities, which disturb soils.
3. Designate areas of construction. Specify areas that are not to be disturbed.
4. Specify entry and exits, location for equipment, storage, waste disposal areas, major structural and nonstructural controls, surface water flow direction, etc.
5. Include topography, slopes, drainage patterns, existing storm drains and discharge points.
6. Measure area, determine drainage patterns, and calculate runoff coefficient.

C. Erosion & Sediment Control Plan Contents
1. Select erosion and sediment controls based on the most appropriate for the site.
2. Indicate the control measures you will use and mark their location on the site map. Contractor to make and date plan revisions as needed.

3. Contractor to prepare a biweekly inspection and maintenance plan (include comment and signature area).
4. Additional stabilization measures are required if an area sits idle for more than 14 days. Where construction activities will resume within 21 days, stabilization is not required until activities cease.
5. Contractor is to certify the plan. Signature of an authorized representative must review and certify that the information is true, and assume liability for the plan.
6. For sites with a common drainage location that serves an area of 10 or more disturbed acres at one time, a temporary sediment basin providing 3600 cubic feet of storage per acre drained is required, (or equivalent control measures until final stabilization is reached.)

D. Plan Location
1. A copy of the SWP3 plan must be kept on the construction site from the time the project starts until it reaches final stabilization.
2. The plan must be available to the inspector.
3. Submit the Notice of intent (NOI)
4. Following completion of the SWP3, contractor must submit their NOI or CSN at least 2 days prior to starting a project. Send the original to State of Texas by registered mail with return receipt at the address on the back of NOI form. Fax or mail a copy of the NOI to SAWS (the local MS4 operator).

E. Construction/Implementation
1. Contractor to implement erosion and sediment controls specified in the SWP3, insure proper installation of controls by performing and documenting regular inspections. The TPDES general permit requires inspection by a qualified inspector every 14 days or within 24 hours of a storm event (0.5 inches or more). Keep all controls in good operating condition until final stabilization. Record all inspections and keep with the SWP3. Correct any deficiencies in the SWP3 before the next inspection to avoid penalties. Minimize the offsite vehicle tracking of sediment and the generation of dust.

F. Update/Change the SWP3
1. The SWP3 must accurately reflect any day-to-day changes at the site. Contractor is to revise the plan to show any changes the contractor makes to correct measures that are not effectively controlling/minimizing pollutant discharges from the site.

G. Notice of Termination (NOT)
1. The NOT is submitted under two conditions:
   a. After "final stabilization" and the facility no longer discharges storm water associated with construction activities; or
   b. When there is a change of contractor

H. Environmental Protection Agency Region 6:
1. www.epa.gov/earth/r6/6en/w/sw/home.html

I. T.C.E.Q.:
   1. www.tceq.state.tx.us/publications/gi/145/ch11.html

J. S.A.W.S.
   1. www.saws.org

K. SAWS Contacts
   1. Construction Compliance Section, Erik Hobson, Supervisor 233-3536

L. Storm Water Quality Specialties
   1. Central Bexar County
      a. Albert Vargas 233 3536

M. West of I-10/ I-35 South:
   1. Johnny Avina 233-3562
   2. Robert Morales 233-3561

N. Central South and East South:
   1. Matthew Apaez 233-2419

O. Eastern Bexar County
   1. Amber Lovell 233-3836

P. Fax:
   1. (210) 704-7596

Q. SAWS Mailing Address:
   1. P.O. Box 2449 San Antonio, TX 78298- 2449

R. SAWS Physical Address:
   a. 2800 U.S. Hwy. 281 N. San Antonio, TX 78212

END OF SECTION 31 00 00

SECTION 31 23 00 – EARTH MOVING

PART 1 - General

1.1 Reference Standards

A. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shadow Depth)

B. TXDOT - Texas Department of Transportation.

1.2 Quality Control

A. New Construction
1. Foundation Design
a. Design in accordance with Geotechnical recommendations.
b. Soil Investigation Data
c. Soils report will be referenced in the contract documents and available to bidders. It will not be bound as a part of the Construction Documents. This cost is part of the project overhead and will be included in the project budget.
2. Boring Log
a. Boring log will be used in the contract documents and available to bidders. It will not be bound as a part of the Construction Documents. This cost is part of the project overhead and will be included in the project budget.

B. Renovations
1. Foundation Design
a. Design in accordance with Geotechnical recommendations. Consideration shall be made of existing foundations and potential interfaces.

PART 2 - Products

2.1 Materials

A. Select Structural Fill
1. Structural fill under building foundations shall be per Geotechnical recommendations.

PART 3 - Execution

3.1 Preparation

A. Preparation and Layout
1. Preparation and layout shall be by a Land Surveyor registered in the State of Texas hired by the Contractor.
2. Establish extent of excavation by area and elevation; designate and identify datum elevation.
3. Set required lines and levels.
4. Maintain bench marks, monuments and other reference points. Reestablish if disturbed or destroyed at no cost the owner.

B. Protection
1. Protect bench marks, and existing neighboring buildings, fences, roads, sidewalks paving and curbs against damage from vehicle and vehicular traffic.
2. Protect excavations by shoring, bracing, sheet piling, or other methods, as required to prevent cave-ins or loosed from dirt falling excavations.
3. Notify Project Manager of unexpected sub-surface condition discontinue work in the area until the Project Manager provides notification work in the area until Project Manager provides notification to resume work

END OF SECTION 31 23 00

SECTION 31 63 29 – DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - General

1.1 Reference Standards

A. Codes and Standards

1. In addition to complying with all pertinent codes and regulations, comply with ACI 201.2R Guide to Durable Concrete "Texas Department of Transportation" ACI 318 "Building Code Requirements for Structural Concrete"; whichever is more stringent. Construction tolerances shall conform to the provision of ACI 117 "Specification for Tolerances for Concrete Construction and Materials"

1.2 Quality Control

A. New Construction

1. Foundation
   a. Design in accordance with geotechnical recommendations. Soil Investigation Data Soils report will be referenced in the contract documents and available to bidders. It will not be bound as a part of the Contract Documents. This cost is part of the project overhead and will be included in the project budget.
2. Boring Log
   a. Boring log will be referenced in the contract documents and available to bidders. It will not be bound as a part of the Contract Documents. This cost is part of the project overhead and will be included in the project budget.
   b. Unit Price Schedules
   c. Unit price schedules shall be included for overage and underage. Payment will be applied on net differences of overage and underage.
3. Casing
   a. If the possibility of casting exists, provide casing as base bid item with deductive allowance in unit price schedule if not used.

PART 2 - Products

2.1 Materials

A. Refer to section 03 00 00 concrete

PART 3 - Execution

3.1 Installation

A. Take every precaution to reduce the hazard of open holes. Cover during non-working hours with ½" plywood, 36" square. Mound 6" of dirt over plywood. Keep unauthorized persons, especially minors, at a safe distance.

3.2 Footing Inspection

A. The same Geotechnical Engineer who performed the project subsurface investigation shall perform the designated duties described herein. The Contractor shall be responsible for coordination of the drill pier inspections.

3.3 Protection

A. Protect bench marks, and existing neighboring buildings, fences, roads, sidewalks paving and curbs against damage from vehicle and vehicular traffic.

B. Protect excavations by shoring, bracing, sheet piling, or other methods, as required to prevent cave-ins or loosed from dirt falling excavations.

C. Notify Project Manager of unexpected sub-surface condition discontinue work in the area until the Project Manager provides notification work in the area until Project Manager provides notification to resume work

END OF SECTION 31 63 29

Division 32 – Exterior Improvements

32	00	00	Exterior Improvements
32	12	43	Permeable Surfacing
32	13	16	Decorative Concrete Paving
32	14	00	Unit Paving
32	30	00	Site Improvements
32	84	00	Planting Irrigation
32	90	00	Planting
32	90	01	Tree Preservation

Division 32 – Exterior Improvements

SECTION 32 00 00 – EXTERIOR IMPROVEMENTS

PART 1 - General

1.1 Scope of Standard

A. This standard provides general guidance concerning the specific preferences of Alamo Community College District for Exterior Improvements for a project

1.2 General Requirements

A. Consultant should review the status of the following items and determine whether any of the following apply:
1. Zoning Platting
2. Traffic Impact Analysis
3. Right of Way Permit
4. Barricade Permit
5. Curbs and Sidewalks Permit
6. Sidewalk/Traffic Lane Closure Permit Sign Permit
7. CSA Handbook for Flatwork Construction
8. Quickclaiming existing ROW Tree Affidavit/Permit Application Landscape Plan
9. Tree Preservation Plan
10. Floodplain Development Permit
11. Stormwater Pollution Prevention Plan & Permit
12. Edwards Aquifer Contributing/Transition Zone Plan & Permit
13. Historic Review
14. Archeological Review
15. Endangered Species Review
16. Texas Department of Licensing and Regulation Architectural Barriers Permit
17. Interlocal Agreement

1.3 Site Plan

A. Show entire lot, not just as part of a lot or lease lines. Should the lot be unusually large, a location detail may be used.

B. All easements, right-of-ways, and existing structures shall be shown.

C. Show existing and proposed sidewalks, approaches and curbs within the right-of-way and on the property.

D. Show existing and proposed parking layout, including access aisles. Number of parking spaces shall conform to City of San Antonio criteria.

E. Show location of the building within the site. Building setbacks shall conform to City of San Antonio criteria.

F. Parking lot cannot drain over sidewalks; it must have sidewalk box drain.

G. All striping accessible parking and signs must be complete. Accessible ramps must ramp into sidewalk, not into parking area.

H. Any drains in City ROW or easements must meet City specifications and be inspected by Public Works Inspectors.

I. The design of a pavement section should be based on a geotechnical report.

1.4 The following restrictions apply with the construction of curbs, sidewalks, and driveways in City ROW:

A. Where new curb are installed, a pavement tie -in must be made to the existing pavement.

B. When laying new curb, curb lines and grades require the City Engineer's approval. The Traffic and Engineering Division of the City's Public Works Department can provide the engineering/surveying analysis (plan and profile sheets) needed to establish curb lines and grades. Coordinate the engineering/surveying services with the surveying section, allowing adequate time for delivery of services. To expedite the development, the owner may contract with a private consultant to furnish the required plan & profile sheets together with cut sheets for submittal review.

C. Where existing, curbs and sidewalks must comply with TAS and/or ADA, otherwise the non-conforming curb and/or sidewalk are required to be reconstructed; the public works inspector to make the on-site determination.

D. Engineer to meet with City ROW management department to review existing condition of sidewalks.

E. A building permit includes construction of sidewalks and driveways but does not include any utility construction in the right-of-way. A permit obtained from the Public Works Department Right-of-Way Management Division is required for all work proposed to be done within City Public right-of-way.

1.5 Fences and Walls

A. No fence or wall, or portion thereof, shall exceed one-hundred (100) horizontal feet in length unless one of the following architectural features visible from the paved surface of the street is provided as part of the fence: a column or pillar; or articulation of the surface plane wall by incorporating plane projections or recesses having a depth of at least one (1) foot and extending a horizontal distance not less than three (3) or more than twenty (20) feet. These provisions do not apply to a fence or wall constructed of brick, masonry, or iron fencing that is at least fifty percent (50%) open voids

PART 2 - Products

2.1 Concrete sidewalks, driveways, and riprap shall conform to TxDOT Specifications and City of San Antonio Specifications.

2.2 Parking lots shall be asphalt on top of flexible base on top of geofabic if necessary. Material shall conform to TxDOT Specifications.

2.3 Concrete pavement shall be used for dumpsters, in front of dumpsters, bus stop locations, motor pools and docks

END OF SECTION 32 00 00

Division 32 – Exterior Improvements

SECTION 32 12 43 – PERMEABLE SURFACING

PART 1 - General

1.1 Selection Includes

A. Permeable Surfacing: Provide for the following applications as indicated on the Drawings:
1. Paths and Trailways
2. Driveways
3. Sidewalks and Walkways
4. Parking Lots
5. Unique Features
6. Drainage Applications
7. Over pour
8. Tree Surrounds

1.2 Design/ Performance Requirements

A. Independent Test Data of Permeable Surfacing:
1. Porosity: Calculated void content of 27 percent.
2. Permeability: Coefficient of permeability for a 6-inch diameter core sample of 5.98x101 inches/second. Flow rate for a 6-inch diameter core sample of 0,043 CF/Sec.
3. Compressive Strength:
4. 10,000 lbs Test: Average reading after 4 hours after release, 0.0609
5. 20,000 lbs Test: Average reading after 3 hours after release, 0.0350
6. Durability: Weathering: Accelerated Weathering in accordance with ASTM D 4798, Cycle A, ASTM G 155. Xenon UV exposure, 120 hours.
7. Durability: Freeze-Thaw: ASTM C 666, Method B, 300 cycles of freeze/thaw; Panel 1 Mass Change minus 1.2 percent, Panel 2 Mass Change minus 0.5 percent, Panel 3 Mass Change plus 5.6 percent. No change in visual appearance from all panels
8. Slip Resistance: Static Coefficient of Friction when tested in according to ASTM D 2047, Average of 0.66
9. Safety: Critical Fall Porous Pave XLS: Tested in accordance with ASTM F 1292, maximum critical fall height of 4 feet.
10. Safety: Critical Fall Porous Pave XLS with Foam: Tested in accordance with ASTM F1292, maximum critical fall height of 7 feet.
11. Safety: Chemical Leaching: EPA Tested for metals, mercury, semivolatiles; The analyte was not detected at or above the reporting limit.
12. Flame Resistance: Tested in accordance with ASTM E 84, Flame Spread Index 90, Smoke developed Index 600.

1.3 Submittals

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Project specific shop drawings shall include as a minimum: plan view, cross-section, and product data.

D. Selection Samples: For each finish product specified, two complete sets of color charts representing manufacturer's full range of available colors and patterns.

E. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic cleaning and maintenance.

1.4 Quality Assurance

A. Manufacturer Qualifications: Manufacturer with a minimum for three years documented experience with the products specified

B. Installer Qualifications: Personnel or authorized agents experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

C. Pre-Installation Meetings:
   1. Convene a pre-installation meeting a minimum of two weeks prior to start of porous surfacing system.
   2. Verify project requirements, sub-base and base conditions, manufacturer's installation instructions and coordination with other related work.
   3. Require attendance of parties directly affecting work of this section, including the Contractor, Architect, engineer, and installer. Manufacturer's representative may attend by phone conference as needed.
   4. Review installation procedures and coordinate installation with other work around installation area.

1.5 Delivery, Storage, and Handling

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Binder components shall be shipped in sealed water-tight containers.

C. Granite aggregate shall be shipped in commercial-grade, moisture-proof 50 lb pre-measured bags.

D. Storage: Store materials in accordance with manufacturer's instructions.

E. Store binder above 45 degrees F. Rock and stone must be kept dry and stored out of direct sunlight to prevent condensation inside the bags

F. Handling: Protect materials during handling and installation to prevent damage.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic maintenance as required.

1.6 Project Conditions

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not place Hard Surface Porous Paving System when the following conditions exist.
1. Unstable wet, saturated, muddy or frozen base.
2. During rain or snow.
3. When air temperature is less than 45 degrees F or more than 95 degrees F for at least six hours after installation.

C. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas is completed.

D. Protect partially completed porous surfacing against damage from other construction traffic when work is in progress.

1.7 Warranty

A. Warranty: Porous Pave material, when installed by certified Porous Pave personnel or authorized agents, will carry a warranty for materials of two years from the date of installation. Porous Pave's warranty is limited to the structural and mechanical integrity of the installed materials

PART 2 - Products

2.1 Manufacturers

A. Basis of Design Manufacturer: Porous Pave Inc.,

B. Requests for substitutions will be considered in accordance with provisions of Design Standards

2.2 Materials

A. Permeable Surfacing: Pour-in-place permeable paving material. With 27 percent void space with 5,800 gallons per hour per square foot permeability.
   1. Porous Pave XL - Blend consisting of 50 percent recycled rubber chips and 50 percent kiln-dried aggregate, plus a Hard Binder, for hard-wearing permeable pavement.

B. Kiln-Dried Aggregate: Washed, kiln-dried, consistently sized all-granite aggregate.

C. Recycled Rubber Chips: Clean, consistently sized rubber chips, 99 percent of steel fragments removed. Consistent rubber chip colors are infused not just a thin outer coating.
   1. Standard Colors
      a. Black
      b. Gray
      c. Tan
      d. Green
      e. Brown
      f. Cypress
      g. Redwood
      h. Blue
   2. Custom Color Combinations
      a. Gray-Black
      b. Tan-Black
      c. Brown-Black
      d. Brown-Tan
      e. Cypress-Black
      f. Green-Brown
      g. Red-Black
      h. Blue-Gray

D. Hard Binder: B5HN hard binder.

E. Soft Binder: B5SN soft binder.

2.3 Fabrication

A. Mix permeable surfacing components to the base mixing ratio required for the mix and color specified.
   1. Mix in mortar mixer 45-60 seconds or until material is evenly coated with binder, over-mixing may change the color of the material.
   2. Mix different colors separately.

PART 3 - Execution

3.1 Examination

A. Do not begin installation until substrates have been properly prepared.

B. Verify layout, gradients and elevations of subgrade and base are correct. Notify the Engineer if not acceptable. Do not begin preparation or installation until unsatisfactory conditions have been corrected.

C. Ensure that adjacent hard-surfaced paving work is completed before installing porous pavement system.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 Preparation

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Carefully protect adjacent materials not to receive surfacing to avoid exposure to binder or mix. Materials will stain and cannot be cleaned.

3.3 Installation

A. Install in accordance with manufacturer's instructions.

B. Install each area to be surfaced in a single monolithic pour with no expansion strips.

C. Provide two inches of XL over a compacted aggregate base for low-speed traffic areas, including loading docks.

D. Provide 1 inch of XL as an over pour on existing concrete, asphalt and wood to cover cracked surfaces to avoid tear-out of existing surface.

E. Provide 1 inch of XLS as an over pour on existing concrete surfaces, wood decks, etc. for a soft touch surface.

3.4 Protection

A. Protect installed products until completion of project.

B. Protect adjacent materials.

C. Protect porous surfacing until fully cured.

D. Avoid construction traffic over installed surfacing.

E. Touch-up, repair or replace damaged products before

END OF SECTION 32 12 43

SECTION 32 13 16 – DECORATIVE CONCRETE PAVING

PART 1 - General

1.1 Reference Standards

A. American Concrete Institute (ACI)

B. Concrete Reinforcing Steel Institute (CSRI)

C. American Society of Testing and Materials (ASTM)

1.2 Quality Control

A. ACI "Recommended Practice for Measuring, Mixing, and Placing Concrete", current edition

B. ASTM C 94 for requirements for production facilities and equipment

C. Refer to project's geotechnical report for any recommendations regarding pavement design.

D. Mock up samples of any special finish requirements in the field for approval

1.3 General Requirements

A. Decorative concrete paving, as used here, means sidewalks, plazas, or other finished site improvements. Other standards will address structural or hidden concrete applications.

B. Driveways, streets, loading docks or other such heavy-duty concrete pavements should be specified elsewhere.

C. Decorative concrete paving shall be 5 inches thick

D. Reinforce with #4 bars at 12" on center

E. Dowel into adjacent flatwork and building foundations

F. Cross slope on decorative concrete paving shall not exceed 2% (two percent). decorative shall not be used

G. Sidewalk surfaces shall not be used as drainage ways. without ACCD approval

H. It is recommended that all pedestrian walkways have a longitudinal slope not to exceed 1:20, or it would be considered to be a ramp. Any pavement over 1:20 longitudinal slope must have handrails and conform to Texas Accessibility Standards (TAS) and ADA requirements for ramp design.

PART 2 - Products

2.1 Materials

A. Concrete and appurtenant materials shall conform to applicable requirements of the City of San Antonio's Standard Specifications for Public Works Construction or Texas Department of Transportation specification.

B. Exposed aggregate or "pebble -finish" concrete is not recommended for pedestrian walkways due to higher potential for being slippery when wet, becoming a potential slip-and-fall hazard.

PART 3 - Execution

3.1 Finishing

A. Decorative concrete paving should be finished by brooming or sandblasting to yield a reliably non-skid surface for pedestrian safety

END OF SECTION 32 13 16

SECTION 32 14 00 – UNIT PAVING

PART 1 - General

1.1 Reference Standards

A. Interlocking Concrete Pavement Institute (ICPI)

B. American Society of Testing and Materials (ASTM)

1.2 Quality Control

A. Provide from one source to ensure consistency

B. Submit samples for color and shape, as necessary

C. Specify construction mockups

1.3 General Requirements

A. General
1. Design consultant should anticipate the use of unit paver surfaces by maintenance, emergency, or mass transit vehicles, and provide an appropriate pavement design section design capable of accommodating vehicle weights and turning movements.
2. Vehicular traffic applications should be coordinated with a civil engineer for proper base course and/or structural substrate design.

B. Solid Concrete Paver Units
1. Concrete unit pavers are preferred in paving areas where access to underground utilities might be expected.
2. Concrete unit pavers should always be installed on top of a sand leveling bed. The sand leveling bed may be installed over a concrete pavement substrate, or a well-prepared and compacted base course. Sand leveling beds should never be installed over only compacted subgrade.

C. Open-cell Concrete Paver Units
1. Open-cell concrete paving units, finished with turf, are discouraged from use due to difficulty in maintaining turf, especially in parking areas, where the paving unit is exposed to the surface.
2. An acceptable alternative application is to install the open- cell pavers on a compacted base course and fill cells with topsoil, then cover with minimum 4 inches of topsoil and install

turf. This application is recommended only at fire lanes, where a wide paved surface may be visually unacceptable.

3. Open-cell concrete paving units cells may be finished with stabilized gravel in lieu of turf. This application may be exposed to the surface.

D. Edge Restraints

1. Metal or plastic edging products are not acceptable edge restraints for campus use.
2. Concrete unit pavers should be retained at their edges by concrete curbs, building or wall foundations, or adjacent concrete paving.
3. An acceptable edge restraint is to mortar the perimeter concrete pavers to a concrete beam below grade, and infill with concrete pavers on a sand leveling bed. This may be used where a concrete curb edge restraint is visually unacceptable.

E. Brick Paver Units

1. Brick paver units are preferred in paving areas where a higher degree of finished aesthetic appeal is desired.
2. Thin-section brick paver units should be installed only over a rigid (concrete) substrate.
3. Thick brick paver units may be installed on a sand leveling bed, over a properly-prepared base course. Attention must be paid to the edge restraint.
4. Thin brick paver units should always be mortared to the concrete substrate.

PART 2 - Products

2.1 Concrete Paving Units

A. Brick Paver Units

1. ASTM C 936

B. Mortar Setting Bed Material

1. Portland Cement, ASTM C 150, Type I or II
2. Hydrated Lime, ASTM C 207, Type S, or depending on application
3. Aggregate, ASTM C 44
4. Water, potable

PART 3 - Execution

3.1 Not Used

END OF SECTION 32 14 00

Division 32 – Exterior Improvements

SECTION 32 30 00 – SITE IMPROVEMENTS

PART 1 - General

1.1 Project Requirements

A. Project must comply with the site furnishings requirements of an approved campus-specific master plan (if any).

B. Specific products may be identified and required by campus physical plant personnel

1.2 Reference Standards

A. Product manufacturer's recommendations for installation and maintenance

1.3 Quality Control

A. Provide only products approved for use by campus physical plant personnel.

B. Specify products specifically intended for outdoor applications.

PART 2 - Products

2.1 Benches

A. Metal benches are preferred. Subject to specific selection, all benches should be powder-finish coated metal, Hunter Green in color. Multiple manufacturers offer product lines meeting this general requirement, some of whom are: Columbia Cascade; Conceptual Site Furnishings; Landscape Forms; Victor Stanley.

B. Bike Racks

1. Painted or galvanized steel, "ribbon" racks, by various manufacturers. If possible, select from same manufacturer as benches and trash receptacles, for continuity. Embed or anchor to a concrete surface.

C. Trash Receptacles

1. Metal, powder-coat finish, Hunter Green in color. Coordinate internal container type and size with campus maintenance personnel. Multiple manufacturers offer product lines meeting this general requirement, some of whom are: Columbia Cascade; Conceptual Site Furnishings; Landscape Forms; Victor Stanley.

D. Ash Urns
   1. If and as required, select a unit that has a closed top to allow butts to be inserted, but which is not open to the environment. If possible, select from same manufacturer as benches and trash receptacles, for continuity.

E. Signage
   1. Refer to Division 10 "Signage" elsewhere in these standards and to the Graphic Standards manual.

F. Pole -Mounted Light Fixtures
   1. Consider minimizing use of pole -mounted light fixtures, capable of being damaged by campus maintenance activities.
   2. Select from square vs, round and/or tapered poles as standard.
   3. Type of lamp should be coordinated with each campus for visual uniformity in colors of lighting.
   4. Multiple manufacturers offer product lines meeting this general requirement, some of whom are: Architectural Area Lighting (Hubble); Bega; Luminis; Philips Gardco; Hubbell; Philips.

G. Indirect Landscape Lighting
   1. It is recommended that pedestrian pathways and gathering places be indirectly lit by using directional tree-mounted downlights. Mountings shall in no way harm the tree.

H. Emergency Telephone Kiosks
   1. Design consultant should ask if there is a campus-specific requirement for these. Often there is a specific manufacturer is desired by the campus.

PART 3 - Execution

3.1 Not Used

END OF SECTION 32 30 00

Division 32 – Exterior Improvements

SECTION 32 84 00 – PLANTING IRRIGATION

PART 1 - General

1.1 Project Requirements

A. Provide new design and equipment compatible with and to complement existing campus infrastructure and satisfactory to the District Director of Construction.

B. Design consultant should interview campus physical plant director and maintenance personnel for irrigation system preferences and experiences.

C. Irrigation system shall be operated by an automatic controller, located inside new building in maintenance room.

D. Irrigation system and controller design shall include a rain sensor device.

E. Design system so that no water is directed onto building faces or across pedestrian walkways.

F. Irrigate only areas of new planting.

G. System design should emphasize efficient use of water, including providing drip and bubbler in lieu of rotor and spray heads.

H. System design should include provision for Central Satellite

I. Control of functioning of system.

J. Existing controllers should be upgraded as required to facilitate conversion to remote control. New controllers should be selected to include this feature.

K. For campuses in San Antonio's jurisdiction, the preparation of irrigation plans shall conform to requirements by the City's Department of Development Services governing project documentation. This includes, among other things, tabular display of performance and friction loss calculations, and signed affidavit indicating design conformance with City requirements.

1.2 Reference Standards

A. ASTM D 1785: PVC Plastic Pipe, Schedules 40, 80, and 120

B. ASTM D 2241: PVC Pressure-rated Pipe (SDR Series)

C. ASTM D 2466: PVC Plastic Pipe Fittings, Schedule 40

D. ASTM D 2564: Solvent Chemicals for PVC Pipe and Fittings

E. City of San Antonio Uniform Development Code

1.3 Quality Control

A. Design of underground irrigation system shall be by current Texas-licensed Landscape Irrigator.

B. Installation of system shall be by current Texas-licensed Landscape Irrigation Installer, with documented 5 years of continuous experience of successful installations.

C. District Director of Construction and/or campus physical plant director should review and approve design prior to the beginning of installation.

D. The design consultant should observe the installation of the system for compliance with design requirements and proper installation techniques.

E. Trenches should be observed for proper installation and bedding before being covered up.

F. Design consultant should specify an extended warranty on system components and function.

1.4 Submittals

A. Provide record drawings of actual installation to campus Physical Plant Director.

B. Provide 3 (three) spares of each type of sprinkler head and nozzle used on the project to the campus physical plant director.

PART 2 - Products

2.1 Acceptable Manufacturers

A. Design consultant should coordinate selection of manufacturer of system components with each campus.

B. Each campus may emphasize one manufacturer over another.

C. For example, the SAC campus utilizes Rain Bird components exclusively.

D. Rain Bird and Toro/Irritrol are acceptable manufacturers for the components of an automatically controlled, underground irrigation system. Intended substitutions should be submitted in writing by the design consultant for approval.

PART 3 - Execution

3.1 Not Used

END OF SECTION 32 84 00

Division 32 – Exterior Improvements

SECTION 32 90 00 – PLANTING

PART 1 - General

1.1 Project Requirement

A. By reference, the City of San Antonio's Landscape Ordinance is made part of this Standard, for campuses that are within the City of San Antonio's jurisdiction.

B. For campuses that are in San Antonio's jurisdiction, a project must comply with the requirements of the City of San Antonio's Landscape Ordinance. Design consultant should obtain a copy of the ordinance (it is available online) and be familiar with its requirements.

C. A landscape plan is required as part of the building permit process.

D. For campuses that are in San Antonio's jurisdiction, the design consultant should coordinate with the City of San Antonio's Development Services department to ascertain landscape plan requirements. It is recommended that the consultant review the landscape plan with the department prior to its formal submittal.

E. Depending on site and project design conditions, landscape plan will have to earn up to 70 points. Points are earned for successful compliance with requirements for parking lot shading, street yard planting, parking lot screening, etc. Mandatory compliance with streetscape tree planting may apply if a project site fronts a public right-of-way.

F. Project must comply with the recommendations of an approved campus-specific master plan (if any).

1.2 Project Design Requirements

A. Design consultant should interview campus-specific physical plant and maintenance personnel for information regarding preferences, selection and application of landscape and plant materials. Specific products or sources may be identified and required by campus physical plant personnel. Plant material preferences should be considered seriously by the design consultant.

B. Plant material selections should be reviewed by campus- specific physical plant and maintenance personnel for compatibility with maintenance practices.

C. Plant material selection should focus on drought-tolerant species and avoid plants that have high maintenance requirements.

D. Selection of plant materials should be guided by xeriscape principles.

E. Provision of large, homogenous areas of turf should be carefully considered by the design consultant. Landscape budget and campus maintenance requirements will also affect the provision of large areas of turf. Where turf is provided, consideration should be given to its irrigation requirements; select species that have a lower water demand. Sports or recreation fields will have their own specific design requirements.

F. All newly-planted areas will be required to be irrigated.

G. Attention should be paid to the design of landscape and irrigation at faces of buildings so that maintenance activities will not damage building face or disrupt activities inside. Irrigation water should not contact the building face.

H. To avoid its potential for damaging landscape, it is encouraged that roof drainage be conducted via downspouts to underground connections to storm drains. Where this is not possible, design consultant should anticipate release of water from downspouts, scuppers, or sheet flow from roof and plan for minimizing its effects on landscape.

I. Visual and physical security should be considered when designing the landscape so that no hiding areas or blind spots are created.

J. Landscape design in parking lots should not create hiding places and should also anticipate mature size of plant materials in islands so that plants do not impinge onto parking spaces. Design consultant should coordinate selection and location of trees and shrubs with locations of parking lot lighting and overhead power / communication lines.

1.3 Reference Standards

A. City of San Antonio Landscape Ordinance, current version

B. American Standard for Nursery Stock, Standardized Plant Names, current edition

C. Texas Association of Nurseryman, Grades & Standards

D. Association of Official Agriculture Chemists

1.4 Quality Control

A. Landscape contractor shall have been in active, continuous business for 5 preceding years and have successfully completed at least 3 commissions of similar size and scope.

B. Do not make substitutions without approval of landscape architect.

C. Landscape architect should have the authority to reject unsatisfactory plant material.

D. Provide samples of topsoil and mulch.

E. Provide soil analysis of area of proposed planting work.

F. Landscape architect should participate in plant selections at the nursery

1.5 Project Warranty Requirements

A. Contractor shall maintain all plant material until substantial completion. Any plant that dies or exhibits unsatisfactory growth, as determined by the design consultant, shall be replaced prior to substantial completion at no additional cost to the project.

B. All plant material shall be alive and shall be good, viable specimens prior to substantial completion. Substantial completion is not an exercise to identify dead or unsatisfactory plant material.

C. Contractor shall warranty all plant material for one year from date of substantial completion, except for defects resulting from neglect by owner, vandalism, or other incidents beyond the contractor's control.

D. At end of one-year warranty period, at the discretion of the owner, a follow-up inspection will be made. Any plant that is dead or exhibiting unsatisfactory growth, as determined by the design consultant, shall be replaced with plants of the same species, size, at no additional cost to the owner. This is only a one-time replacement.

PART 2 - Products

2.1 General

A. The plant list contained in the appendix to the City of San Antonio's Landscape Ordinance may be consulted as a general guide to plant materials appropriate to this region.

B. Biodiversity is encouraged in the composition of a planting palette by the City of San Antonio's Development Services department.

C. Certain plant materials may be emphasized from campus to campus, if required by an approved campus-specific master plan.

D. Plant materials shall be container-grown, unless B&B material is specifically specified.

E. For purposes of this Standard, the following plant materials, abstracted from the list, are recommended for general compliance with criteria of drought-tolerance, survivability, availability, and compatibility.

2.2 Landscape Materials

A. Topsoil
1. Fertile, friable, surface soil complying with ASTM D 5268

B. Mulch
1. Shredded organic mulch. Garden-Ville, or approved equivalent.

C. Fertilizer
1. For planting soil mix, shall be per recommendation of soil analysis

D. Appurtenant Materials
1. As required by campus physical plant

2.3 Plant Materials

A. The following list of recommended plant materials is comprised of plants that are either native to or perform reliably in San Antonio. They are also commercially available. The list is not exhaustive. Other plants not listed here may be equally reliable or available, and the design consultant is encouraged to be creative in compiling a plant palette. Campus maintenance personnel should be consulted regarding any campus-specific requirements. Design consultants unfamiliar with plants on this list are encouraged to research their suitability for specific applications.

B. Trees
1. Bald Cypress (Taxodium distichum)
2. Bur Oak (Quercus macrocarpa)
3. Cedar Elm (Ulmus crassifolia)
4. Chinquapin Oak (Quercus muhlenbergii)
5. Desert Willow (Chilopsis linearis)
6. Live Oak (Quercus virginiana)
7. Mexican Buckeye (Ungnadia speciosa)
8. Monterrey Oak (Quercus macrophylla)
9. Pecan (Carya illinoensis)
10. Persimmon, Texas (Diospyros texana)
11. Possum Haw (Ilex decidua)
12. Red Oak, Texas (Quercus texana)
13. Redbud, Texas (Cercis canadensis var. texana)
14. Sycamore, Mexican (Platanus mexicana)
15. Texas Mountain Laurel (Sophora secundiflora)
16. Texas Pistache (Pistacia texana)
17. Vitex (Vitex agnus-castus)
18. Yaupon Holly (Ilex vomitoria)

C. Shrubs

1. American Beautyberry (Callicarpa americana)
2. Butterfly Rose (Rosa chinensis 'Mutabilis')
3. Button Bush (Cephalanthus occidentalis)
4. Cenizo, Silvercloud (Leucophyllum candidum 'Silvercloud')
5. Cenizo, Greencloud (Leucophyllum frutescens 'Green Cloud')
6. Coppertone Loquat (Eriobotrya x coppertone)
7. Dwarf Wax Myrtle (Myrica pusilla)
8. Grayleaf Cotoneaster (Cotoneaster glaucophylla)
9. Green Santolina (Santolina chamaecyparissus 'virens')
10. Indian Hawthorn 'Springtime' (Raphiolepis indica 'Springtime')
11. Jack Evans Hawthorn (Raphiolepis indica 'Jack Evans')
12. Lantana, New Gold (Lantana x 'New Gold')
13. Lantana, Ham and Eggs (Lantana camara)
14. Native and Antique Roses
15. Red Yucca (Hesperaloe parviflora)
16. Rosemary, Upright (Rosmarinus officinalis)
17. Roughleaf Dogwood (Cornus drummondii)
18. Sago Palm (Cycas revoluta)
19. Sandankwa Viburnum (Viburnum suspensum)
20. Softleaf Yucca (Yucca pendula)
21. Southern Wax Myrtle (Myrica cerifera)
22. Twisted Leaf Yucca (Yucca rupicola)

D. Groundcovers
1. Coral Honeysuckle (Lonicera sempervirens)
2. Katie Ruellia (Ruellia brittoniana 'Katie')
3. Lantana, Purple (Lantana montevidensis)
4. Liriope (Liriope muscari)
5. Monkey Grass (Ophiopogon japonicus)
6. Rosemary, Prostrate (Rosmarinus officinalis 'Prostratus')

E. Perennials
1. Autumn Sage (Salvia greggii)
2. Blue Mist Flower (Eupatorium coelestinum)
3. Bulbs
4. Butteryfly Weed (Asclepias spp.)
5. Cigar Plant (Cuphea micropetala)
6. Evergreen Daylily (Hemerocallis sp.)
7. Firebush (Hamelia patens)
8. Gayfeather (Liatrus spp.)
9. Heartleaf Hibiscus (Hibiscus martianus)
10. Indigo Spires (Salvia farinacea x longispicata)
11. Mexican Bird of Paradise (Caesallpinia pulcherrima)
12. Mexican Bush Sage (Salvia leucantha)

13. Mealy Cup Sage (Salvia farinacea)
14. Mexican Oregano (Poliomentha longiflora)
15. Mexican Petunia (Ruellia sp.)
16. Pigeonberry (Rivina humilis)
17. Pink Evening Primrose (Oenothera speciosa)
18. Pink Skullcap (Scutellaria suffrutescens)
19. Rock Rose (Pavonia lasiopetala)
20. Russian Sage (Perovskia atriplicifolia)
21. Shrimp Plant (Justicia spp.)
22. Texas Yellowbells (Tecoma stans var. angustata)
23. Turk's Cap (Malvaviscus drummondii)

F. Grasses, Turf
1. Bermuda Grass (Cynodon dactylon)
2. Buffalo Grass (Buchloe dactyloides)
3. Zoysia (Zoysia sp.)

G. Oranmental Grasses
1. Bamboo Muhly (Muhlenbergia dumosa)
2. Gulf Muhly (Muhlenbergia capillaris)
3. Miscanthus
4. Maiden Grass (Miscanthus sinensis)
5. Mexican Feather Grass (Stipa tenuissima)
6. Miscanthus (Miscanthus sinensis)
7. Muhly Grass (Muhlenbergia lindheimeri)
8. Nolina (Nolina texana)

H. Palms
1. Dwarf Palmetto (Sabal minor)
2. European Fan Palm (Chamaerops humilis)
3. Texas Palmetto (Sabal texana)
4. Windmill Palm (Trachycarpus fortunei)

PART 3 - Execution

3.1 General

A. Planting beds shall be a minimum 12 inches deep.

B. Turf should be installed over 4 inches of topsoil.

C. Preparation of subgrade should be by General Contractor and turned over to the Landscape Contractor for application of topsoil or planting soil mix.

D. Mulch depth shall be 4 inches.

E. For trees 4 inch caliper and greater: tree pit diameter minimum 4 feet greater than diameter of root ball; depth equal to depth of ball.

F. For trees 4 inch caliper and less: tree pit diameter minimum 2 feet greater than diameter of ball; depth equal to depth of ball.

G. Do not stake trees unless absolutely necessary.

H. Palm trees should be staked for at least one year after planting.

END OF SECTION 32 90 00

SECTION 32 90 01 – TREE PROTECTION

PART 1 - General

1.1 Project Requirement

A. By reference, the City of San Antonio's Tree Preservation Ordinance is made part of this Standard, for campuses that are within the City of San Antonio's jurisdiction.

B. For campuses that are in San Antonio's jurisdiction, a project must comply with the requirements of the City of San Antonio's Tree Preservation Ordinance. Design consultant should obtain a copy of the ordinance (it is available online) and be familiar with its requirements.

C. Submittal of a tree preservation plan and tree affidavit form is required as part of the building permit process.

D. For campuses that are in San Antonio's jurisdiction, the design consultant should coordinate with the City of San Antonio's Development Services department with any questions about the application of the ordinance's the tree preservation plan with the department prior to its formal If the design consultant is not familiar with the tree species inhabiting a project site, consulting with a registered arborist is recommended.

E. Design Consultant should be aware that trees existing on a project site are not evaluated and protected by the ordinance simply on the basis of size. Species is equally important and this provision protects smaller native trees that will never attain a large girth.

1.2 Special Project Recommendation

A. Because of the value that accrues to mature trees that may exist on a project site, it is recommended that the campus consider digging and relocating trees that would otherwise be removed by construction.

B. The design consultant should be aware that, although the success rate for digging and relocating trees is high if done by qualified contractors, the ordinance nevertheless counts a dug and relocated tree as a 'removed' tree. This can have an impact on the calculation of percentage of caliper inches retained. It is recommended that the design consultant review with the City's Development Services department any plans to dig and move trees. Generally, they will respond favorably to this option.

1.3 Project Design Requirements

A. Site survey for a project should include location, size, and species of all trees on the site that qualify for the protections described in the ordinance. The design consultant should insist on a proper site survey before commencing tree preservation work.

B. The ordinance identifies trees requiring protection by size and by species. Trees scheduled for protection are classified as either 'significant' or 'heritage'. Significant trees can be removed without penalty as long as at least 40% of their overall quantity (as measured by caliper inches) is retained. Heritage trees may not be removed. If they are removed, a 3:1 mitigation is required on the project site.

C. The quantification of trees to remain and trees to be removed is by caliper inches of trunk, not by actual numbers of trees.

D. The design consultant should be aware of the definitions of and distinctions between significant and heritage trees. For example, some small trees (e.g., mountain laurel) are classified as 'heritage' trees at a caliper inch size of 8 inches, while for large trees (e.g., live oak), the 'heritage' classification begins at 24 inches. Yet, both are protected equally under the 'heritage' category.

E. The tabulation and calculations required by the ordinance are detailed d therein.

F. It is strongly recommended that the design consultant visit the project site to confirm the content and accuracy of the site survey. Discrepancies should be brought to the attention of the surveyor and corrected prior to completion of the Tree Preservation Plan.

G. The design consultant should be aware that an inspector will visit the site to confirm the content and accuracy of the tree protection plan. Conditions different than those represented on the tree protection plan are subject to penalties.

1.4 Reference Standards

A. City of San Antonio Tree Preservation Ordinance, current version

1.5 Quality Control

A. Professional arborist certified by the International Society of Arboriculture

B. Tree Pruning must comply with the National Arborist Association's "Pruning Standards for Shade Trees"

PART 2 - Products

2.1 Not Used

PART 3 - Execution

3.1 General

A. Erect and maintain tree protection barricades at the specified distance from the trunk. Do not allow construction work, storage of material, or parking inside the barricaded area for the duration of the project.

END OF SECTION 32 90 01

Division 33 – Utilities

33 00 00 Utilities

Division 33 – Utilities

SECTION 33 00 00 – UTILITIES

PART 1 - General

1.1 Scope of Standard

A. This standard provides general guidance concerning the specific preferences of Alamo Community College District for utilities for a project.

1.2 General

A. Utility Companies
   1. Gas and Electric Service
      a. CPS Energy (210) 353-4050
   2. Sewer and Water Service
      a. San Antonio Water System (210) 704-7297
   3. Telephone Service
      a. Southwestern Bell Company 820-7539
   4. Cable TV Service
      a. Time Warner Cable 352-4460

B. Utility Plan
   1. Consultant will prepare a Site Utility Plan to provide private water and sanitary sewer service to within 5 feet of the building. Gas, electric and telephone services will be indicated on the plan as provided by the MEP or electrical contractor. All utilities shall be placed underground. Easement descriptions for CPS Energy gas and electric services will be prepared as required during the Construction Phase. All utility service locations will specified by the building construction plans. MEP engineer shall provide consultant the size and location required for gas, electric, and sewer and water services out of each building. Architect and MEP engineer to provide any backflow prevention requirements to Civil Engineer.

C. Water Plan
   1. Proposed water line design shall conform to TCEQ, SAWS rules and regulations or Bexar Met rules and regulations and any other governing entity ordinances or codes.
   2. Show location of existing water mains.
   3. Show proposed water mains and services.
   4. Show service sizes.
   5. Water mains shall be a minimum of 9 feet from any sanitary sewer mains.

D. Backflow Prevention

1. Design should conform to SAWS Cross Connection Control and Backflow Prevention Program manual.
2. Provide freeze protection.

E. Fire Code Review Requirements
1. Fire hydrant location:
2. No more than 300 feet along a direct line; or 500 feet along the route of travel.
3. Water flow.
4. Fire flow pressure test.
5. Use of building/space.
6. Fire Department access.
   a. Show ingress, egress and turnaround space when required by current Fire Code. The requirements are based on building distance to street, size, use, etc.

F. Sewer Plan
1. Proposed sanitary sewer lines shall comply with TCEQ, SAWS rules and regulations and any other governing entity ordinances or codes.
2. Show location of existing sewer mains.
3. Show proposed sewer mains and services.
4. Show service sizes.
5. No life stations unless approved by ACCD.

G. Drainage Plan
1. Design the building finished floor above the 100-year ultimate floodplain elevation or 25-year floodplain elevations plus 0.5’ of freeboard, whichever is higher.
2. Submit calculation for any storm sewer system.
3. Onsite lines shall be designed for a 25-year storm period.
4. Show location of existing storm sewer lines.
5. Show proposed storm sewer lines.

PART 2 - Products

2.1 Water - water materials shall conform to SAWS.

2.2 Sewer - sewer materials shall conform to SAWS Specifications or SARA Specifications.

2.3 Drainage - drainage pipe shall be concrete or plastic and shall conform to TxDOT Specifications or City of San Antonio Specifications.

2.4 Inlets and manholes shall conform to TxDOT Specifications or City of San Antonio Specifications.

END OF SECTION 33 00 00