



Pima Community College

Facilities Guidelines and Specification Standards

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TAB A-1

INTERNATIONAL SUITE OF CODES

The College has adopted the 2012 International Suite of Codes and the 2011 National Electric Code as design criteria for all new construction and renovation projects. The use of the 2012 suite of codes, the 2011 NEC and amendments is effective immediately and are herein incorporated into the College's Design and Specification Standards. The approved and adopted codes are as follows:

2012 Edition

- International Fire Code
- International Building Code
- International Mechanical Code
- International Plumbing Code
- International Fuel Gas Code
- International Residential Code

2011 Edition

- National Electric Code

End of Tab A-1

TAB A-2

AS-BUILTS & RECORD DRAWINGS

Accurate Record Drawings are an important component to the overall project success. These records are often referenced by the College for maintenance and repair activities and future renovation and modification projects. All disciplines require careful record keeping to provide the most accurate and complete information as possible for the project record. It is strongly recommended that project documents are updated on a regular basis to ensure information is captured while the project is under construction. Capturing information while project memory is strong saves time and helps minimize having to go back to search for key information.

As-Builts and Record Drawings shall be prepared for all Pima Community College projects.

During construction, the Contractor shall maintain a clean set of As-Built drawings to record all as-built and record information. This information shall be kept current and in compliance with applicable standards and general requirements. PCC may additionally require that every month, as a condition for progress payment, the Contractor shall make available their as-built drawings for review to ensure that they are being maintained and that the updated information is accurate, clear and legible. Once the As-Builts are complete every drawing in the set shall be marked in a consistent fashion near the bottom of the sheet and adjacent the Title Block with the words "AS-BUILTS" and the submittal date.

At the end of construction these As-Built drawings will be transmitted to the Design Professional for their review and action towards the preparation of the Record Drawings. The Design Professional shall promptly review these As-Builts and notify the contractor of any information that may be missing. Both the Contractor's As-Builts and the Design Professional's Record Drawings shall incorporate drawing revisions that occurred during the course of construction as a result of RFI's, ASI's, Change Orders, etc.

Once the Record Drawings are complete every drawing sheet in the set shall be marked in a consistent fashion near the bottom of each sheet and adjacent to the Title Block, with the words "RECORD DRAWINGS" and the submittal date. In addition, the revision title block listing shall show as its last entry the date of the record drawing submittal and referenced accordingly. The date for every sheet within the complete set shall be the same.

Record Drawings are not required to be sealed as the original construction documents were.

Where the original drawings were produced using AutoCAD the record drawings should also be produced in AutoCAD. Refer to respective agreements and contracts and coordinate with PCC Project Manager for specific formatting requirements of electronic files.

It is critical to the quality of the As-Builts and Record Drawings that both be accomplished in a timely fashion when information is fresh and resources are still available.

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TAB B-1

LABORATORY PLANNING & DESIGN CRITERIA

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NOTE:

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

- **General Laboratory Planning and Design Precepts**
 - Utilize a central core for special spaces, shared spaces, and building service areas
 - Array laboratories around the perimeter of the building
 - Locate offices and circulation spaces between the core and the perimeter labs
 - Separate office spaces from the labs
 - Maintain adjacency and visibility to labs
 - Provide a hierarchy of office spaces
 - Faculty
 - Laboratory Supervisor
 - Laboratory Specialist/Technician
 - Provide a variety of informal gathering spaces, with tack and marker boards in each
 - Eddy spaces in corridors (in addition to lab door recesses)
 - Lounges
 - Breakrooms
 - Consider providing clean and “dirty” corridors
 - Clean corridors are restricted to people circulation
 - “Dirty” corridors cannot be considered as secondary means of egress
 - “Dirty” corridors provide:
 - Utility distribution
 - Air distribution systems
 - Lab equipment (refrigerators, etc.)
 - Building equipment (compressors, air pumps, etc.)
 - Circulation route for sensitive items
 - Air pressurization hierarchies are critical
 - Ensure adequate space provisions for major equipment
 - Restrict size of main corridor (refer to NFPA 101) to prohibit placement of equipment
 - Utilize a hierarchy of equipment spaces:
 - Shared group spaces in the core
 - Floor space allowance in the “dirty” corridor
 - Open floor and/or space in each lab
 - Available floor space for cart parking
 - Bench top space for analytical equipment (as appropriate)
 - Recess out swinging lab doors off the corridor
 - Ensure adequate provisions for bulk storage

- Provide storage for all types of materials required:
 - Dry goods
 - Chemicals
 - Bottled gasses
- Utilize a hierarchy of distributed storage spaces:
 - General building storage
 - Floor closets
 - Lab closets
 - Millwork cabinets
 - Open and/or closed shelving
- Design bulk storage areas with appropriate fire resistance ratings for materials and quantities
 - Bulk chemical storage facilities should have these characteristics:
 - Perimeter location
 - Vented room
 - 2-hour fire resistant construction
 - Consider including “blow out” panel
 - More than 10 gallons (in the aggregate) of class I chemicals must be stored in a cabinet
 - Provide adequate floor space in chemical storage rooms for individual cabinets
- **Flexible Laboratory Planning**
 - Plan lab facilities with a distributed hierarchy of shell space for future build-out
 - Floor shells and/or wing shells, as appropriate
 - One or more module shells
 - Semi-custom shells
 - Special shells
 - Provide complete utility service into each shell
 - Plan laboratories as "generic" spaces
 - Accommodate different categories of generic labs
 - Wet
 - Dry
 - Teaching
 - Research
 - Biology
 - Chemistry
 - Biochemistry
 - Electronic

- Geology
- Physics
- Engineering

- Accommodate "exceptions" and unique conditions in separated custom-purpose spaces
 - Animal holding
 - Biohazard activities
 - Cold rooms (storage or working)
 - Electron microscope
 - Environmental
 - Laser
 - Radioisotope activities
 - Tissue culture activities

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

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

- Design lab infrastructure with flexibility to accommodate different categories of labs and/or future design changes without a need to revise the infrastructure systems
 - Piped utility distribution
 - Waste and vent systems
 - Air management
 - Power supply

- Ensure that all equipment and appurtenances maintain the flexibility established in the basic planning and design
 - Modular benches, wall cabinets, shelving
 - Removable benches to allow increasing equipment floor space
 - Coordinate lab top seams with joints in casework
 - Allowance for items such as cylinder racks

- **Modular Laboratory Planning**
 - Design labs using a planning module

 - Module selection should incorporate the following determinants:
 - Building structure (and vibration considerations)
 - Typical bench needs and sizes for each lab category
 - ADA access requirements
 - Ceiling panel modules
 - Epoxy top modules

 - Maintain consistent modular planning throughout the facility

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

- Provide for unique "in-lab" needs within the module or multiple modules

- Provide complete array of utility stubs to each module, even if not always distributed

- **Accessibility in Laboratories**
 - Design typical lab benches to be 34" high
 - Provide sit-down handicapped accessible workstation in each lab
 - Appurtenances for each HC station will vary with the category of lab, but in general should include
 - Bench at approximately 30" high, but no more than 34"
 - Hood
 - Sink with wrist blade faucet handles
 - Lab gasses with wrist blade cock handles
 - Power
 - Storage facilities
 - Writing surfaces
 - Appurtenances must be within regulation-specified reach distances
 - Investigate whether sit-down writing surfaces available to all lab users could be designed to accommodate an HC station when needed
 - Investigate whether removable benches and/or equipment could be designed to allow retrofit for HC accessibility

- **Planning and Design for Laboratory Safety**
 - Resolve lab exiting issues
 - Investigate a design scheme which utilizes "lab suites" thereby allowing individual lab doors to be left open while preventing true corridor doors from being blocked open
 - Investigate providing magnetic hold open / pneumatic closer devices on lab/corridor doors
 - Chemicals management
 - More than 10 gallons (in the aggregate) of class I chemicals must be stored in a cabinet
 - Provide acid, solvent, and/or flammable storage cabinets for supply chemicals as appropriate in each lab
 - Under hood or free standing as required by quantity to be stored
 - Properly vented
 - Cabinets should be compartmented to allow segregation of chemicals
 - Provide space for storage of waste chemical containers

- Utilize chemical fume hoods only for lab processes, not for storage
- Utilize canopy hoods and/or snorkels to remove heat only. In some cases, snorkels are used to remove chemical fumes.
 - Autoclaves
 - Dishwashers
 - Certain analytical equipment
- Provide emergency showers with "hands free" eyewash in corridors
 - Locate within 50 feet of each lab door
 - Do not provide showers in labs
 - Provide a local warning alarm for water flow
- Provide flexible hose eyewash at each major bench sink (If eyewash/shower not provided)
- Provide adequate space, outside traffic areas, for waste handling
 - Provide secured storage/space for sensitive waste
 - Provide vented storage/space for hazardous waste (maximum 5-gallon container)
 - Utilize a distributed hierarchy of waste spaces
 - Building
 - Floor
 - Individual labs
 - Waste categories include:
 - Ordinary trash
 - Recycled paper
 - Other recyclables
 - Broken glass (secured)
 - Waste chemicals (secured, vented)
 - Red bag (secured)
 - Orange bag (secured)
 - Radio-hazard (secured)
- Provide a separate break away from labs. Provide space for microwave, refrigerator, coffee pot, sink, etc.
- Provide vision lite in every lab/corridor door
- Provide a fire extinguisher rated for materials being used in lab on a hook in each lab room
- Alarm systems
 - Provide mini-horn/strobe units in environmental rooms and in labs
 - Do not provide smoke detectors in corridors
- Biosafety levels

- Not all laboratories present a biohazard condition requiring primary and/or secondary barriers
- Hazards are classified by biosafety level, and required physical barriers are described
- Biosafety level 1
 - Handwashing sink
- Biosafety level 2
 - Class I or II biosafety cabinets may be required
 - Waste decontamination facilities
- **Laboratory Casework**
 - Provide wood casework
 - Natural finish, not plastic laminate
 - Except where matching existing metal
 - Except in areas requiring impervious surfaces
 - Animal care areas
 - Biohazard areas
 - Radioisotope areas
 - Chemical storage rooms
 - Include utility chase behind wall/peninsula/island base cabinets
 - Demonstrate functional usability of corner area where two base cabinets intersect
 - Provide removable access panels at knee spaces and sink cabinets
 - Rear stretcher at knee space should be continuous
 - Provide pull out writing tablet in casework, using drawer glides
 - Provide heavy duty full extension drawer glides (100 pounds minimum)
 - Provide pre-fabricated specialty chemical and flammable storage cabinets where required
- Laboratory bench tops
 - Epoxy resin tops at all wet or semi-wet areas
 - Acid resistant plastic laminate at dry areas
 - Provide dished top at all major lab sinks
 - Provide lip at all sinks in labs
 - Locate seams in tops coincident with seams in benches to allow for modifications
 - Use light colored tops if lighting efficiency can be demonstrated
- Wall/peninsula/island reagent shelving (above lab benches)
 - Custom fabricated using unistrut-type system (not stock item)
 - Extend unistrut from floor through bench top to structure above
 - Seal penetration with epoxy seaming material
 - Do not use a "wrapped splash"

- Earthquake lip (12" or 18" clear dimension)
- Acid resistant plastic laminate on wood substrate
 - Do not use an epoxy paint or clear finish
- Do not install reagent shelving above sinks
- Enclosed wall reagent cabinet (above lab benches)
 - 12" clear dimension
 - Glass or opaque doors as requested by User
 - Do not install wall cabinets above sinks
- Wall shelving (non-reagent)
 - Must have backing in wall
 - Clear finish wood
 - Heavy duty adjustable kv-type brackets
 - End caps
 - Use unistrut-type reagent shelves for extra deep wall shelving
 - Install top-most shelf 24" minimum below ceiling
 - Do not install wall shelving above sink
- **Laboratory Equipment and Accessories**
 - Provide a 3'-6" minimum single leaf at each lab/corridor door
 - Discuss fume hood selection with PCC Facilities Design & Construction and Environmental, Health & Safety
 - Investigate special user requirements
 - Laminar flow clean hoods
 - Radioisotope hoods
 - Perchloric acid hoods
 - Biosafety cabinets
 - Exhaust hoods (chemical)
 - Laminar flow clean hoods
 - Used only to protect process (not to protect operator)
 - Not exhausted
 - Radioisotope hoods
 - Special purpose fume hood with HEPA-filtered exhaust discharge
 - Generally uses slightly higher face velocity than conventional fume hoods (125 fpm)
 - Requires welded stainless steel exhaust duct system
 - Can be open or gas-tight (glove box)
 - Biosafety cabinets

- Identify specific type of hood required, based on User process
- Class I biosafety cabinet: 100 fpm, single pass air, out through HEPA filter
- Class II-A biosafety cabinet: 100 fpm, 70% recirculated through HEPA, 30% exhaust to room through HEPA
- Class II-B1 biosafety cabinet: 100 fpm, 30% recirculated through HEPA, 70% exhausted to exterior through HEPA

- Biosafety cabinet exhausts may be manifolded together, but not with chemical fume hoods

- Exhaust hood control
 - For chemical fume hoods that are not user controllable, they must be on 24 hours
 - Also includes radioisotope and hoods
 - Consider off-hours setback and VAV systems, for energy conservation
 - Interior recirculation ("supply") fans of biosafety cabinets may be User controllable
 - Must be interlocked with hood and/or general exhaust fans to ensure that operator safety and room pressure are not compromised
 - Applies to all class II biosafety cabinets, only
 - Provide tank farm with chains, not dividers, when required
 - Design to be near the door, for ease of service
 - Utilize College-standard tank manifold
 - Provide wall space for PCC-standard towel and soap dispensers at each lab sink
 - Provide tack surfaces and writing boards in all labs
 - Carefully coordinate all equipment specifications
 - Fixed or moveable, must specify details
 - Sizes and floor space allowances
 - Use electric autoclaves instead of steam

- **Laboratory Finishes**
 - Floor finishes
 - Available choices
 - Vinyl composition tile is appropriate for most labs
 - Epoxy sealer is also appropriate for most labs, including chemistry
 - Seamless vinyl provides a "pan" in very wet areas
 - Seamless vinyl is cleanable for biology labs
 - Continue flooring under casework
 - Seal toekick of all benches (to prohibit water penetration)
 - Use topset cove base at toekicks

- Provide epoxy wall paint in all wet labs
 - Also on ceilings, if hard surface
- Ceilings
 - Available options
 - Suspended acoustical tile ceilings are acceptable in most laboratories
 - No ceiling is an option where appropriate
 - Provide hard ceilings only where required by lab activity
- Provide a sealed sleeve with a lip at all floor penetrations
- **Laboratory Utility Service and Distribution**
 - Utilities distribution
 - Overhead, in corridor ceiling
 - Valve on each utility stub, in corridor
 - Drop on wall surface or freestanding to each lab bench
 - Distribute to positions in utility space at rear of casework
 - Make joints in horizontal piping only at removable panels
 - Visible and accessible
 - Consider special delivery systems where appropriate
 - Lab gas "pedestal" or "drop pods"
 - Electric "drop cords"
 - Utilities on bench tops
 - Place turrets toward rear of bench
 - Use turrets with angled discharge to enhance hose management
 - Utilities racked on reagent shelf
 - Generally avoid (hoses get in the way)
 - If doing so, rack on unistrut verticals, not shelf
 - If doing so, maintain 22" clear height above bench top
 - Piped utilities
 - distribute to benches and hoods
 - controls must be outside hoods
 - Building provides central

- Potable water
- Reversed osmosis water
 - Provide special (di) polish at individual labs
- Natural gas
 - Some Users prefer bench top cylinders for gas service
- Compressed air
 - Confirm if required
- Building does not provide central
 - Vacuum (provided by newer labs)
 - Hot water (provided by newer labs)
 - Specialty gasses (provided by newer labs)
 - Provide in individual lab as needed
- Use building chilled water wherever possible for process
 - Provide heat exchanger between building and process
 - Recirculate chilled water (do not use "single pass")
 - Where demand is excessive, varies from building system, or need is critical
 - Use standalone chiller
 - Consider placing chiller on emergency power system
- Waste system and piping
 - Do not use acid neutralization systems (building or stand-alone)
 - Separate lab waste from domestic waste
 - Utilize separate piping system to exterior of building
 - Provide sampling manhole for lab waste piping
 - Combine lab and domestic waste piping after sampling manhole
 - Use acid-resistant piping system for lab waste
- Lab sinks
 - Confirm with User need for large/deep sinks
 - Plan major sinks at ends of benches, in base cabinet
 - Use gooseneck faucets with wrist blades at all sinks
 - Cup sinks are not routinely needed on benches or in hoods
 - Install only is specifically required
 - Always provide lip
 - In hoods, sink must be at rear to avoid trap being in under-hood storage cabinet

- Do not use plastic di faucet
 - Aluminum faucet (with plastic piping) is acceptable
 - Self-closing
 - Easily replaceable
- Floor drains
 - Per Pima County Wastewater, no drains on lab floors.
- Electrical & telecommunications typically required
 - Provide an adequate number and arrangement of circuits
 - Provide an adequate number and arrangement of 120v receptacles
 - Provide an adequate number and arrangement of 208v receptacles
 - Provide wiremold electrical distribution above all lab benches
 - Double raceway
 - Install quantity of receptacles as required by User process
 - Receptacles above bench must have GFCI protection within 5' of water source
 - Install of data jacks as required by User in second raceway
 - Label each receptacle's circuit
 - Alternate circuits in each lab and in each wiremold run
 - Provide wall phone jacks where required. Do not provide data jacks at wall phone jacks
 - Provide date jacks along benches where required.
- Lighting
 - Place general fixtures to eliminate shadows from work surfaces
 - Do not rely on general fixtures for the complete lighting environment
 - Provide task lighting above lab benches and other work surfaces
 - Utilize LED fixtures with diffusers to minimize glare
 - Evaluate color and reflectivity of finishes and bench tops as part of lighting design
 - Provide emergency lighting in each lab room or distinct space
- **Laboratory Air Management Technology**
 - Preferred system
 - Building ahu to supply make up air to labs
 - Lab fan coil units to remove sensible cooling load of lab equipment
 - Investigate manifold and VAV exhaust system if project has many hoods
 - Use multiple fans in manifolded system
 - To allow programmed maintenance

- Basic system design issues
 - Provide pressure hierarchy between lab spaces
 - Provide capability to measure velocity and pressure downstream of terminal boxes
 - Provide exhaust discharge velocity of 3000 - 3500 fpm
 - Provide bypass on manifold VAV systems at roof
 - Provide filtration or scrubbing for hazardous emissions
- Temperature control
 - St individual room thermostats at 75°F, ± 2°F
- Humidity control – discuss with PCC FDC
- Filtration requirements
 - Provide minimum 4" deep 30% efficiency filter banks in 100% outside air systems
- Design exhaust systems for materials being removed
 - Heavier or lighter than air
 - Concentrations and processes
 - Discuss design hood face velocity with PCC FDC and Environmental Health & Safety
 - Limit use of canopies and snorkels to heat removal
 - Ductwork materials
 - Spiral 316L stainless steel shall be used for fume hood applications
 - PVC coated galvanized may be used on manifold VAV systems applications
 - Clearly specify strict construction controls
 - Welded 316L stainless steel must be used for perchloric acid hoods
- Design exhaust system for noise reduction
 - Duct size, design, and route
 - Fan selection and location
 - Low pressure drop hood
- Specify appropriate vent conduits for storage cabinets
 - Explosive / flammable
 - Vapors

End of Tab B-1

TAB B-2

CUSTODIAL PLANNING & DESIGN

Custodial Services are inherent to the operations of buildings and proper service areas must be considered with all other areas during the programming and planning stages of each building.

Universally accepted standards have yet to be set for custodial closets and storerooms. Certain criteria however, for size, shape, location, and special appurtenances, have been developed which are compatible with present cleaning procedures and today's cleaning equipment.

Comprehensive custodian operations encompass three major areas:

- Custodial Closets
 - Custodian Storage Areas
 - Trash Disposal Systems
- CUSTODIAN CLOSETS

Should be planned to function primarily as the workrooms of men and women responsible for cleaning the interior surfaces of the building. Pima Community College has developed the following criteria for custodian closets:

- Size should be a **minimum** of 50 – 100 square feet, with 7-8 foot minimum width (per campus).
- Recessed light fixtures (to allow for clearance of long broom and mop handles) providing 75 F.C. light.
- Adequate ventilation.
- Hangers for wet mops over the sink.
- Hard surface walls impervious to water.
- Shelves in closet to accommodate supplies in case lots, and to allow for storage of liquids in original 5 or 6-gallon containers (in primary closet).
- Hot and cold-water outlets not less than 24" above a floor type basin. Basin curb should be 6" minimum above the floor.
- A grounded 20 Amp. Duplex outlet in open wall space, not behind shelves.

Buildings should have custodian closets on every floor. Good locations for secondary custodian closets are:

- Close to elevators
- Close to main pedestrian areas
- Between two restrooms

Criteria for Vertical Transportation

- There should be an elevator in every multi-storied building.
- The elevator should land on every floor including the basement.
- The elevator should be available to custodian and maintenance personnel.

It is considered poor planning to locate a custodian closet:

- At the dead-end of a corridor. A situation such as this results in many unnecessary steps for the custodian.

- On a stair landing. A stair-landing closet would cause the custodian to always carry utensils and equipment up and down stairs.
- Inside another room (unless that closet serves only that room).
- Under stairs. Low ceilings and narrow dimensions are hard to ventilate.
- In narrow spaces. The custodian must move their equipment into the hall to utilize a narrow room. Square shaped closets are most efficient.

Telephone switching gear, elevator controls, electric panels or other service functions are not compatible with custodian operations, and should not be located inside custodian closets. Openings to pipe chases or mechanical equipment areas should not be located inside custodian closets.

- PRIMARY STORAGE ROOMS
 - Every large building should have a storeroom for custodian equipment, bulk supplies and custodian lockers. Storage areas should be designed specifically for custodian storage, not for dual usage. Planning should be done in consultation with those who will be responsible for maintaining the building.
 - Dock or elevator facilities should be provided.
 - Doors should be no less than 36" wide and open out. Storage areas should contain a minimum of 144 square feet. 12' x 12' are good dimensions.
- TRASH DISPOSAL
 - Disposal of the trash and garbage produced by every cleaning operation is an integral part of a comprehensive program. Removal by truck for all trash and garbage.
- SUMMARY
 - Proper custodian closets carefully planned and sized storage rooms or custodial supplies, and consideration of refuse collection and disposal requirements, are prime ingredients in any efficient housekeeping program.

End of Tab B-2

TAB B-3

KEYLESS ACCESS & SECURITY SYSTEM GUIDELINE

Pima Community College has implemented a Keyless Access and Security System program to provide a cost effective, efficient, and maintainable means of providing and managing access into campus buildings for the College community, contractors and visitors. The focus of the system is to address issues of loss prevention, personal safety, and convenience through the use of this standardized technology.

The Guidelines and specifications for Keyless Access and Security System are implemented and managed through Pima Community College Security and Access Control Group. Currently, the Guidelines and Specifications are in process, any matters related to Access and Security should be referred to Pima Community College Access Control.

End of Tab B-3

TAB C-7

ROOM NUMBERING

Obtain building number, address, and room numbers from Facilities Planning at facpln@pima.edu.

All drawings issued for construction shall contain and reference accepted room numbers so that electrical panels, telephone backboards, air distribution devices, as-built information, balance reports, etc. will not have to be cross referenced or revised after occupancy of the space.

Renovation projects shall maintain the same room numbering sequence that presently exists within the building. Obtain a current key plan for the building and fit new room numbers into the existing scheme and the following protocol. Secure acceptance of room numbers from Space Planning & Management before proceeding with any drawing schedules.

New buildings and additions shall generally adhere to the following room numbering protocol:

- All room numbers shall consist of three primary digits.
- The first digit shall identify the floor level. The ground floor is always level G. Multiple basement levels will have to be treated as a special case.
- The second and third digits shall be used to sequentially identify rooms on a floor level (01 to 99).
- A fourth digit may be employed as a prefix to describe an independent building within a cluster or a sizable addition (i.e., N118).
- From the elevator or main floor access; room numbers shall be assigned sequentially in a clockwise fashion left to right. Even numbers shall be used on the right hand side of the corridor and odd numbers on the left hand side. (When walking from the elevator or main floor access.)
- Corridors shall be identified by a large even number and a suffix indicating the direction in which it runs (i.e. 500W).
- Room numbering shall be assigned so as to allow for future room additions (i.e., spread the numbering system out so that infill numbers are available, based on available space).
- An effort shall be made to maintain consistent room numbers for similar elements on each floor (i.e., if bathrooms are located in same area of each floor they should share common room number ending digits).
- Rooms within a room (second order) shall be consecutively labeled alphabetically in a clockwise manner from left to right (i.e., 118A, 118B etc.). Additional rooms (third order) shall be sequentially numbered similarly (i.e., 118A1, 118A2 etc.).
- Open vestibules and alcoves shall not be assigned permanent room numbers. Scheduled door number references should match the room number to which it enters.

END OF TAB C-7

TAB B-5

TREE PRESERVATION, PROTECTION & SALVAGE GUIDELINES

Intent

The College values campus trees for their shade, beauty, history, and architectural importance.

Trees contribute to campus by creating intellectual open spaces and by providing for climate mitigation, carbon sequestration, and storm-water uptake. As the College strives to become more environmentally sustainable, trees lower the “heat island” effects of buildings and pavement and reduce costs for building climate control.

Campus open space objectives include increasing campus shade by expanding the percentage of tree cover.

To support the goal of sustaining the College tree collection, campus projects must include analysis of existing trees during the design process. Site analysis guides the development of a plan to preserve, protect or salvage trees during construction

General Procedures

- Identify unique characteristics of the trees where possible, i.e. Heritage Trees, one of a kind on campus or in the state. Field verify tree identity and location.
- Review proposed project site for impacts to existing trees and prioritize trees for salvage. Collection of additional data (i.e. size, quality) may be necessary.
- Develop a tree assessment plan. Determine and identify the status of existing trees. The status assigned for existing trees on site will dictate the corresponding action to be taken in the following descending order of priority:
 - Retain in place and preserve during construction,
 - Salvage and replant in another campus location (identify new site),
 - Salvage, hold and replant on site,
 - Replace specimen with new planting on site,
 - Propagate tree for planting in another campus location (identify new location),
 - Remove tree
- Prioritize tree salvage and preservation for tree value, budget and aesthetic considerations. Identify responsibilities and funding sources for tree preservation and salvage.
- Review tree assessment plan with the project design team and Facilities Grounds Services. Determine status for all existing trees.
- Monitor tree preservation, salvage, storage, and replanting during construction for compliance with specifications.
- Consideration to be given to the time of year when salvage and transplanting activities are to be undertaken.

End of Tab B-5

TAB B-6

ACCEPTABLE INDOOR AIR QUALITY PLANNING, DESIGN & CONSTRUCTION CRITERIA

CODES AND STANDARDS

- ANSI/AIHA Z9.5-1992: American National Standard for Laboratory Ventilation
- ASHRAE Standard 62-1999: Ventilation for Acceptable Indoor Air Quality, 1999
- Pima Community College Facilities Guidelines and Specification Standards
- SMACNA: IAQ Guidelines for Occupied Buildings Under Construction, First Edition, November, 1995

DESIGN

Purpose: To facilitate communication and improve understanding of indoor air quality issues among members of the design team and between the design team and the College and provide the basis for evaluating indoor air quality issues and the performance of the HVAC system during the commissioning process.

- Identify and document all heating, ventilating, and air conditioning (HVAC) system design requirements, assumptions, and criteria. The following information shall be provided:
 - Indoor design conditions for each building space:
 - Temperature
 - Relative humidity by season
 - Maximum space humidity during all seasons: 50%
 - Pressure relationship between adjacent areas
 - Outdoor design parameters:
 - Dry bulb and wet bulb temperatures
 - Relative humidity
 - Prevailing wind direction by season
 - Building space information:
 - Type
 - Occupancy densities
 - Activities
 - Use patterns
 - Internal loads for each building space:
 - Lighting
 - Equipment
 - People
 - Infiltration
 - Any special or unusual electrical, thermal, or moisture loads

- Any odorous or hazardous pollution sources for which additional measures, e.g., local exhaust, additional dilution ventilation, are required.
- Criteria utilized to determine outside air requirements for each building space.
- Minimum outside airflow rates shall be clearly indicated on design drawings.
- Classification of air assumptions for exhaust and recirculation air streams shall be in accordance with Appendix A.
- Air cleaning and filtration efficiencies and filter area.
 - Filter area shall be clearly indicated on design drawings.
- Means by which outdoor air quality has been assessed and outdoor air contaminants of concern (if any) and air filtration requirements determined to establish outdoor air intake location(s).
 - The building site shall be surveyed for sources of contaminants (health, odor, or sensory irritation contaminants).
- Criteria used to determine locations of air devices (e.g., supply, return, exhaust, etc.) to ensure proper dilution and mixing of air within each building space.
- Means by which and locations where outdoor air can be measured and balanced.
- Means by which temporary exhaust can be provided in the future to control strong source contaminants during shell space construction. For further information, refer to Appendix B.
- Applicable codes, standards, regulations, etc.
- Narrative describing the design and operation of the HVAC systems during occupied and unoccupied periods.
- Description of HVAC system control sequence of operation and identification of control system setpoints.
- Minimum and maximum flow rates for terminal units.
- Description of building envelop construction, including locations of vapor and air retarders.
- HVAC calculations, including cooling load, heating load, and exhaust flow rate calculations.
- Integrate prudent design principles and features as indicated in the following paragraphs.
 - Locate outdoor air intakes away from known sources of contaminants, including, but not limited to, exhaust and vent outlets, plumbing stacks, emergency generator exhaust stacks, loading dock areas, flue stacks, and areas where people might congregate to smoke. For further information, refer to Appendix C.
 - Preferred location of outdoor air intakes is above roof level.
 - Outdoor air intakes should preferably not be located at ground level.
 - Locate exhaust and vent outlets away from operable windows and doors and property line. For further information, refer to Appendix D.
 - Bird screens shall be located over outdoor air intakes.
 - Bird screens shall be constructed of galvanized or stainless steel. Bird screens shall be ¼-inch mesh.

- Bird screens shall be accessible for cleaning.
- Outdoor air intakes shall be protected from rain entrainment by louvers, mist eliminators, or rain hoods. For further information, refer to Appendix E.
- Recirculation of air (for further information, refer to Appendix A):
 - Recirculation of Class 1 air is allowed.
 - Recirculation of Class 2 air within the same room is allowed; recirculation of Class 2 air is allowed in other rooms if particulates are filtered or the air is sufficiently diluted with Class 1 air.
 - Class 3 air can only be recirculated within the same room.
 - Class 4 air can be exhausted or recirculated if the air is filtered to Class 2 air criteria.
 - Class 5 air must be exhausted.
- Provide access doors to the following components for inspection and cleaning purposes: outdoor air intakes or plenums; upstream and downstream surfaces of cooling and heating coils; air washers; evaporative sections and coolers; other heat exchangers; air cleaners; drain pans; fans, filters, damper sections, humidifiers; and air flow measuring stations (other than unit flow sensors).
 - Access doors shall be factory-fabricated, readily openable, and airtight.
 - Access doors shall be clearly indicated on the design drawings.
 - Access doors shall be clear of all obstructions and provide full access.
 - Air handling unit access doors shall be full man-doors or as large as equipment will allow.
 - Ductwork access doors shall be as large as ductwork will allow. If possible, ductwork access doors shall have a minimum size of 18-inches by 18-inches; 24-inch by 24-inch access doors shall be provided where possible. Hard ceiling or wall access doors shall be fire-rated and have a minimum size of 24-inches by 24-inches.
- Air handling equipment shall be designed for no water droplet carryover. The MDSS requires air-handling equipment to have draw-through cooling coils having a maximum face velocity of 400 fpm properly and evenly distributed across the face of the cooling coil.
- Drain pans shall be pitched towards the drain and shall be appropriately trapped. For further information, refer to Appendices F and G.
- No internal exposed thermal insulation is permitted except as allowed by the MDSS.
 - Supply ductwork shall be wrapped on its outside surface with thermal insulation in accordance with the MDSS.
 - Internal exposed thermal insulation shall not be installed in medical areas, clean rooms, or high velocity ductwork.
 - Internal exposed thermal insulation may be used in acoustically critical applications where the College's written permission has been obtained.
 - If permitted, internal exposed thermal insulation shall be elastomeric closed cell, cleanable, non-biodegradable, impermeable to water and moisture, and secured with welded pins and non-flammable adhesive. Internal exposed thermal insulation must have metal nosing or sleeves over leading edges at fan discharge, around access door openings, and at any point where the insulation is preceded by internally uninsulated duct. Internal exposed thermal insulation shall be kept away from intake screens, mist eliminators, louvers, and rain.
- Air handling equipment and ductwork shall not be constructed of porous or semi-porous materials, e.g., concrete masonry units (CMU) or gypsum wallboard (GWB).
- Potable water shall be used in direct evaporative humidifiers, air washers, and evaporative coolers.

- Provide humidification only when absolutely necessary or when it is a special project requirement.
 - Utilize steam-to-steam-type humidifiers only.
- Provide continuous water bleed or automatic periodic drain combined with chemical water treatment to control scale and microbial growth in air handling systems designed to recirculate water from an open storage tank or sump of an evaporative cooler, air washer, or evaporative section of air handling equipment.
 - If water treatment chemicals are used they shall not enter the air stream or must be acceptable for use in evaporative equipment and approved for this use by the College Risk Management & Environmental, Health & Safety Department. To determine the acceptability of water treatment chemicals, contact the National Antimicrobial Information Network at 1-800-447-6349.
- Filters shall be selected as appropriate for the application. For further information, refer to Appendix H.
 - Filters for air handling equipment whose flow rate exceeds 4,500 cfm shall have a minimum sixty percent (60%) efficiency pre-filters and final filters with 80-85% minimum efficiency when passing a three (3) micron particle.
 - Filters for all other air handling equipment shall have a minimum efficiency of sixty percent (60%) when passing a three (3) micron particle.
 - Filter area shall be based on 400 fpm face velocity.
 - Filter rack shall be constructed to allow no bypass of air.
- Supply ductwork located in a return air plenum, chilled water supply and return piping, and domestic cold water piping below 55 degrees F shall be properly insulated to prevent condensation from forming. For further information, refer to Appendix I.
- Insulation subject to damage or a reduction in thermal resistivity if it were to become wet shall be enclosed in a vapor retarder.
- Outdoor air intake controls shall maintain no less than ninety percent (90%) of the design outside air flow rate at all times. For variable air volume (VAV) systems, refer to Appendix J.
- Air handling system controls shall include an "optimum start-stop" provision to ensure that acceptable temperature, humidity, and ventilation is provided prior to daily space occupancy. For further information, refer to Appendix K.
- Carbon dioxide (CO₂)-based demand control ventilation may be used, but must have a minimum outdoor air flow rate to control building sources. Refer to ASHRAE Standard 62-1999, paragraph 6.3.1 and Appendix D, "Rationale for minimum Physiological Requirements for Respiration Air Based on CO₂ Concentration" to determine the minimum outdoor airflow rate per person required for a specified CO₂ concentration.
- Construction of the building envelope shall comply with all applicable code requirements relating to the control of water and water vapor penetration, air filtration, and entry of radon and other soil gases.
- HVAC systems shall be designed to provide at all times no less than the minimum total amount of outdoor air required for ventilation by Table 2 of ASHRAE 62-1999.
- Zone minimum airflow rates shall provide minimum outdoor air ventilation airflow rates during space occupancy.
- Mechanical rooms shall not be used as air plenums. Air routed through mechanical rooms shall use hard ductwork only.

- Utility fans serving fume hoods shall have a 3,000 feet per minute minimum discharge velocity in a vertically upwards direction and shall discharge at a minimum of ten (10) feet above the adjacent roof line. For further information, refer to ANSI/AIHA Z9.5.
- Direct evaporative cooling may be used in air handling equipment only after the College's written permission has been obtained.
- Direct evaporative cooling equipment:
 - Must limit space relative humidity to less than fifty percent (50%).
 - Must have no filter bypass.
 - Must be completely accessible, both upstream and downstream, for inspection and cleaning.
 - Must have no water droplet carryover. Manufacturers' recommendations for maximum allowable face velocities must be followed.
 - Must have filters upstream that have a minimum sixty- percent (60%) efficiency when passing a three- (3) micron particle.
 - Must have a water treatment system to prevent scale formation and anti-microbial growth that utilizes potable make-up water, blowdown, and water treatment chemicals.
 - Must use water treatment chemicals that do not enter the air stream or must be acceptable for use in evaporative equipment and approved for this use by the College's Risk Management and Environmental, Health & Safety Department. To determine the acceptability of water treatment chemicals, contact the National Antimicrobial Information Network at 1-800-447-6349.

- CONSTRUCTION

Purpose: To ensure that work procedures and appropriate controls are utilized to minimize degradation of building indoor air quality during construction, renovation, remodeling, and maintenance activities.

- Initial Planning
 - The party responsible for construction, renovation, remodeling, and/or maintenance activities must prepare a plan that addresses how indoor air quality issues will be handled during these activities.
 - If the activity only involves College staff, the responsible party will be a College department, e.g., Facilities Management, Facilities Planning and Construction, Space Management, etc.
 - If the activity involves an outside consultant, the responsible party will be the consultant.
 - The College department or consultant shall contact and consult with the College's Risk Management and Environmental, Health & Safety Department during plan preparation.
 - The plan must be approved by the College's Risk Management and Environmental, Health and Safety Department prior to the beginning of construction.
 - The plan shall include the following information at a minimum.
 - Identification of potential work-related airborne contaminants, e.g., dusts and odorous or hazardous substances.
 - Identification of how contaminants may spread through the building.
 - Identification of how building occupants will be affected by the spread of such contaminants.
 - Identification and selection of feasible, specific control measures to keep dusts and odorous and hazardous substances out of occupied areas. These measures could include work area containment, modification of HVAC operation, reduction of emissions, intensification of housekeeping, rescheduling of work hours, moving occupants, defining re-occupancy criteria, etc.
- Isolation of major construction, renovation, remodeling, and maintenance activities in occupied buildings. For further information, refer to Appendix L.

- Affected areas in occupied buildings shall be isolated from adjacent non-affected areas through the use of temporary walls, plastic sheeting, or other vapor retarding barriers.
- Affected areas shall be maintained at a negative pressure relative to surrounding non-affected areas.
- Recirculating air ducts shall be temporarily capped and sealed. If particulates are the only indoor air quality concern, appropriate filters may be used in place of capping and sealing the ducts.
- Protection of the building HVAC system from dust and moisture during major construction, renovation, remodeling, and maintenance activities in occupied buildings.
 - Supply air systems shall not be operated without filters in place.
 - Filters shall have a minimum sixty- percent (60%) efficiency when passing a three- (3) micron particle.
 - Building materials subject to degradation from ambient environmental exposure shall be protected and replaced if damaged.
 - Air handling equipment and ductwork shall be stored in a clean, dry location prior to installation and openings shall be securely covered to prevent entry of dust, moisture, and general construction debris and dirt.
 - In new construction air-moving equipment shall be used to "flush" the building to reduce off gassing of interior furnishings and finishes a minimum of 48 hours prior to building occupancy. For further information, refer to Appendix M.
 - Temporary filters shall be utilized in the air handling equipment during this period.
 - Filters shall be replaced after the flushing of the building has been completed.
 - Filters shall have a minimum sixty- percent (60%) efficiency when passing a three- (3) micron particle.
- Notification of building occupants of major construction, renovation, remodeling, and maintenance activities.
 - Notify potentially affected building occupants of planned work via Facilities Management's alert notification procedure. A brief description of the work and the precautions that will be taken to protect the occupants' indoor air quality shall be included.
- Substitution of equipment and/or materials:
 - Substitution of equipment and/or materials that may affect the HVAC system or its ability to maintain acceptable indoor air quality shall be reviewed by the College for consistency with documented design criteria.
- Ongoing management after work has begun:
 - Specifications shall be monitored and enforced.
 - Periodic updates on progress shall be provided to building occupants.

APPENDIX A

CLASSIFICATION OF AIR

Return air, transfer air, and exhaust air shall be classified as follows:

Class 1:

Air drawn from spaces without unusual sources of contaminants such as offices, conference rooms, classrooms, lobbies, retail spaces, coffee stations, storage rooms (except those housing high-emitting products such as paint supplies), equipment rooms such as air handling equipment rooms, elevator machine rooms, individual dwelling units including hotel rooms, and electrical/telephone closets.

Class 2:

Air drawn from spaces that may have mild contaminant intensity, such as copy rooms, printer rooms, dining areas and break rooms, kitchenettes or dining areas with ovens or other cooking or food dispensing capability such as steam tables, cafeterias, laundry rooms, locker rooms, residential kitchens (general or hood exhaust), limited access non-residential toilet rooms (such as those in office buildings and other spaces not open to the general public), and residential or single toilet rooms and bathrooms (except those to patient rooms of health care facilities). For the purpose of this section, a copy or printer room is a room whose primary purpose is to house copy machines and printers, respectively. Air drawn from a room housing the occasional or personal copier or printer may be considered Class 1 air. [Air exhausted from limited access non-residential toilet rooms are placed in this category because the expected frequency of use of these facilities, combined with the minimum exhaust air rates prescribed in the Design Section 2.21., generally result in exhaust gases that have mild odor intensity. Exhaust from toilet rooms that are publicly accessible, particularly those that are heavily used at times such as in airports, theaters, and other assembly spaces, can be expected to have much higher contaminant concentrations and thus qualify as Class 3 air.]

Class 3:

Air drawn or vented from locations with significant contaminant intensity, such as nonresidential and public toilet rooms (except those listed above under Class 2), toilet rooms and bathrooms to patient rooms of health care facilities, janitor's closets, commercial kitchens (general and non-grease hoods), laboratories (general exhaust), dry-cleaning processing establishment (general exhaust), indoor swimming pools, diazo printing rooms, and plumbing vents.

Class 4:

Air drawn or vented from locations with noxious or toxic fumes or gases, such as paint spray booth, garages, tunnels, kitchens (grease hood exhaust), chemical storage rooms, refrigerating machinery rooms, natural gas and propane burning appliance vents, and soiled laundry storage.

Class 5:

Effluent or exhaust air having a high concentration of dangerous particles, bio-aerosols, or gases such as that from fuel burning appliance vents other than those burning natural gas and propane, uncleaned fume hood exhaust, evaporative condenser and cooling tower outlets [due to possible microbial contamination such as legionella, the causative agent of Legionnaire's Disease and Pontiac Fever].

APPENDIX B

SUPPLEMENTAL EXHAUST

The design documents shall indicate the means by which supplemental exhaust can be provided to meet the requirements of Construction Section 2.2. This section does not require special systems to be installed since they may be installed on a temporary basis, for example by temporarily removing windows for exhaust fans. Rather, this section requires only that the means be indicated in design documents so that it is available when the need for supplemental exhaust occurs in the future.

It is not uncommon for spaces to be temporarily exposed to strong sources of contaminants, such as during remodeling or after an accidental spill of a volatile liquid. These occurrences may be handled by temporary exhaust systems. In many cases, temporary exhaust is difficult to provide such as, in interior spaces of large buildings. To improve flexibility in future renovations, exhaust systems such as those serving toilet rooms can be designed to include additional capacity that may be manually (or automatically) invoked as needed during the building life. Smoke removal systems might also be used for this purpose if approved by the local fire district.

APPENDIX C

LOCATION OF OUTDOOR AIR INTAKES

[This section requires minimum separation distances for outdoor air intakes from known sources of contaminants adjacent to and in the vicinity of the building in order to minimize the introduction of contaminants.] Outdoor air intakes shall be located such that the distance measured from the closest point of the intake opening to the object, or point, listed in Table C1 exceeds the minimum separation distance listed in Table C1. See also Appendix D for restrictions relative to exhaust air outlets.

Exception:

Shorter separation distances are acceptable if it can be shown that an equivalent rate of introduction of outdoor air contaminants will be attained using an alternative design, and if approved by the authority having jurisdiction.

The distances required in this section are minimums; in general, locating intakes as far as practical from contaminants sources reduces the likelihood of entrainment. Prevailing winds and airflow patterns around the building and building elements may also be important considerations for intake locations.

Table C1
Air Intake Minimum Separation Distance

Object	Minimum Distance, m (ft)
Property line	1 (3)
Garage entry, loading area, or drive-in Queue (Note 1)	7 (25)
Driveway or street	3 (10)
Limited access highway	8 (25)
Mantels or ledges (Note 2)	1 (3)
Landscaped grade (Notes 3, 4)	2 (6)
Roof or grade (Note 4)	0.25 (0.75)
Cooling Towers (Note 5)	5 (15)

Note 1: These areas are likely locations where vehicles will be paused and idling, such as while paying parking fees or waiting for traffic in the case of the garage entry, while loading or unloading materials in case of the loading area, or waiting in line for drive-in restaurant or bank service in the case of the drive-in queue.

Larger separation distances may be needed if the intake is located directly above the likely location.

Note 2: Applies to mantles or ledges that are sloped less than 45 degrees from the horizontal and that are more than 0.15 m (6 in.) wide. [Such ledges tend to become bird nesting or "resting" places.]

Note 3: Landscaped grade is soil, lawn, shrubs, or any plant life within 0.5 m (1.5 ft) horizontally of intake. [The purpose of this section is to minimize the introduction of pollen, odors and vapors from biodegrading materials, pesticides, bacteria, etc. from landscaping.]

Note 4: Intake must be at least 0.2 m (8 in.) above the average maximum snow depth at the intake.

Note 5: Applies to closest wetted surface of tower, such as intake or basin. See Appendix D for separation distance from tower discharge.

APPENDIX D

LOCATION OF EXHAUST AIR AND VENT OUTLETS

Exhaust air and vent outlets shall be located no closer to property lines, outdoor air intakes, windows, and doors, both those on the subject property and those on adjacent properties, than the minimum separation distance S listed in Table D1. S is defined as the shortest "stretched string" distance measured from the closest point of the outlet opening to the closest point of the outdoor air intake opening, window or door opening, or property line along a trajectory as if a string were stretched between them. [For example, if a wall separates an intake from an exhaust as shown The Figure D1 below the distance S is taken from the exhaust outlet in a straight line to the top of the wall over the wall then in a straight line to the intake. In this case, $S = S1 + S2 + S3$.

Figure D1

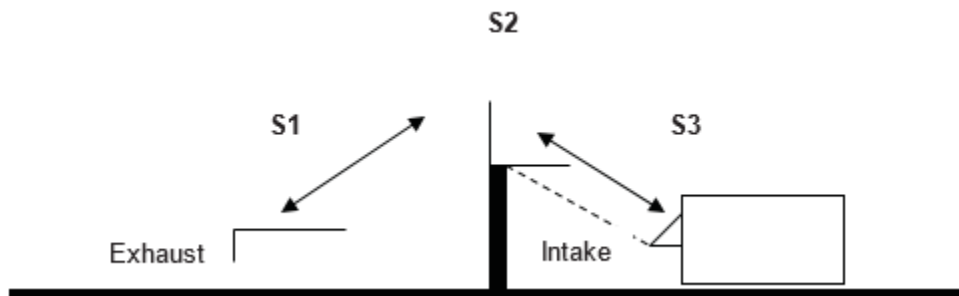


Table D1
Exhaust Outlet Minimum Separation Distance (S), M (ft)

Object	Exhaust Air Class (See Appendix A for Definition)				
	1	2	3 (Note 1)	4 (Note 1)	5 (Note 1)
Outdoor Air Intake	1	2	3 (Note 1)	4 (Note 1)	5 (Note 1)
Operable Window or Door (Note 3)	0.3 (1)	Half of Equation D1 (Note 4)	Half of Equation D1 (Note 4)	Half of Equation D1 (Note 4, 6)	Equation D1 (Note 6)
Property Line	0	1.5 (5) (Note 5)	3 (10) (Note 5)	3 (10)	5 (15)

Note 1: Laboratory exhaust air outlets shall be in compliance with NFPA 45-2011.

Note 2: Class 3, 4 and 5 air outlets that terminate in an equipment well that also encloses an outdoor air intake shall meet the requirements of Table D1 and, in addition, shall either: a) terminate at or above the highest enclosing wall and discharge air upward at a velocity exceeding 5 m/s (1000 fpm); or b) terminate 1 m (3ft) above the highest enclosing wall (with no minimum velocity). For the purpose of this section, an equipment well is an area (typically on the roof) enclosed on three or four sides by walls that are less than 75% free area, and the lesser of the length and width of the enclosure is less than 3 times the average height of the walls. The free area of the wall is the ratio of area of the openings through the wall, such as openings between louver blades and undercuts, divided by the gross area (length times height) of the wall.

Note 3: Operable doors and windows that are required as part of a natural ventilation system shall comply with the row labeled "outdoor air intake."

Note 4: Separation distance S is one half of the requirement of Equation D1.

Note 5: For Class 2 and 3 air, where the property line abuts a street or other publicway, no minimum separation is required if exhaust termination is 3m (10 ft) above grade.

Note 6: For Class 5 exhausts located below intakes or operable windows and doors, distance S in Equation D1 shall be a horizontal separation only; no credit may be taken for any vertical separation.

Where Equation D1 is referenced in Table D1, minimum separation distance S shall be determined as:

$S = 0.04\sqrt{Q(\sqrt{D} - V/2)}$	(5-1a) (SI)
$S = 0.09\sqrt{Q(\sqrt{D} - VA/400)}$	(5-1b) (IP)

Where:

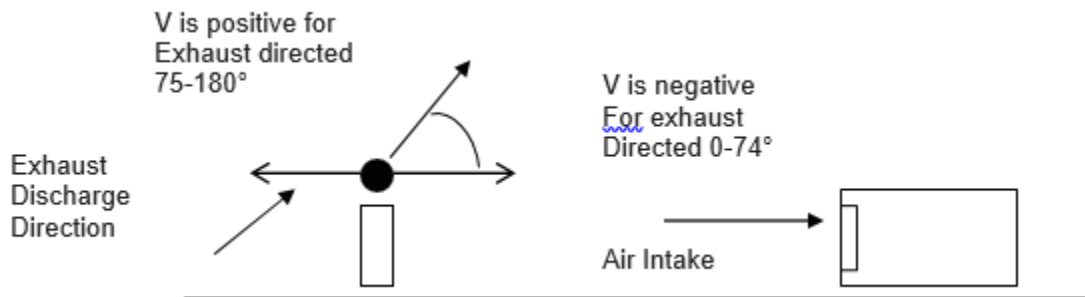
Q = Exhaust air volume, L/s (cfm). The value used in Equation 1l shall not be less than 75 L/s (150 cfm) nor exceed 1500 L/s (300 cfm) regardless of actual volume. For gravity vents such as plumbing vents, use an exhaust rate of 75 L/s (150 cfm). For flue vents from fuel burning appliances, assume a value of 0.43 L/s per kW of combustion input (250 cfm per million Btu/hr) or obtain actual rates from the combustion appliance manufacturer.

D = Dilution factor determined as a function of exhaust air class (see Appendix A) in the table below:

Exhaust Air Class	Dilution Factor, D
1	5
2	10
3	15
4	25
5	50

V = Exhaust air discharge velocity, m/s (fpm). V shall have a positive value when the exhaust is directed 75° to 180° away from the object, and shall have a negative value when the exhaust is directed 0 to 74° towards the object) as shown in Figure D2. V shall be set to 0 in Equation 5-1 for vents from gravity (atmospheric) fuel fired appliances, plumbing vents and other non-powered exhausts, or if the exhaust discharge is covered by a cap or other device that dissipates the exhaust air stream. For hot gas exhausts such as combustion products, an effective additional 2.5 m/s (500 fpm) upward velocity shall be added to the actual discharge velocity.

Figure D2



Exceptions:

- Shorter separation distances are acceptable if it can be shown that equivalent dilution factors will be attained using an alternative design, and if approved by the authority having jurisdiction.

- Outdoor air intakes need not be separated from furnace vents and other fuel-fired appliance vents that are a part of a unitary or factory packaged heating/ventilating unit that is manufactured within 2 years of the publication date of this standard. This exception applies to the separation of the outdoor air intake and vent discharge of the unit itself and does not exempt maintaining separation distances from one unit to another adjacent unit. [The 2-year time delay is to allow manufacturers an opportunity to redesign and remanufacture equipment in order to meet the separation distances required by this section.]

Separation distances do not apply when exhaust system and outdoor air intake systems do not operate simultaneously.

Note: even where the required minimum separation distances are maintained, reentrainment of odors and toxic gases may still occur depending on wind conditions, building geometry, and exhaust design. An analysis of the air flow pattern around buildings and exhaust plume behavior using the methods described in the AHSRAE handbook, Fundamentals, Chapter 14 can provide more accurate information to assess the potential for reentrainment and to determine adequate separation distances.

Equation D1 may be summarized as follows:				Separation Distance At Zero Discharge Velocity	Minimum Discharge Velocity For Zero
Class of Air	Dilution Factor D	Square Root of D (√D)	Minimum (75 L/s. 150 cfm)	Maximum (1500 L/s. 3000 cfm)	Separation Distance
1	5	2.24	2.5	11.0	894
2	10	3.16	3.5	15.6	1265
3	15	3.87	4.3	19.1	1549
4	25	5.00	5.5	24.6	2000
5	50	7.07	7.8	34.9	2828

Example 1:

a 2000 L/s (4000 cfm) dome type exhaust fan used for toilet exhaust (class 3 air per Section 5.4.1) is located on a roof near a rooftop unit. For class 3 air the intake must be located per Equation D1. Since the exhaust fan discharge velocity is not directed away from the air intake (discharge is down to roof which then deflects out evenly in all directions), the velocity in Equation D1 is taken as zero. Since the exhaust volume exceeds 1500 L/s (3000 cfm), the value of Q in Equation D1 is taken as 1500 L/s (3000 cfm). The equation (in I-P units) is solved as:

$$S = 0.09 \sqrt{3000} (\sqrt{15-0}/400) = 19 \text{ ft}$$

Example 2:

Instead of a dome exhaust fan in the previous example, an up-blast exhaust fan is used. The discharge velocity as obtained from manufacturer's data is 6.5 m/s (1300 fpm). The required separation distance is now:

$$S = 0.09 \sqrt{3000} (\sqrt{15-1300}/400) = 3 \text{ ft}$$

Example 3:

The flue from a forced draft 880 kW (3 million Btu/hr) input natural gas boiler is located near an operable window. The discharge air quantity is approximately 380 L/s (750 cfm) assuming 0.43 L/s per kW of combustion input (250 cfm per

million Btu/hr) (per definition of 0 above). The flue is terminated with a flue cap. So no credit for discharge velocity can be taken. However, the flue gas is hot and buoyant and thus a 2.5 m/s (500 fpm) upward velocity may assumed. The minimum separation distance (in SI units) is:

$$S = 0.04 \sqrt{380(\sqrt{50-2.5/2})} \\ = 4.6 \text{ m}$$

As a Class 5 air stream, distance S becomes a horizontal separation distance (no credit for vertical separation) when the discharge is below the window (see Note 6 to Table D1).

Example 4:

A rooftop AC unit has an outdoor air intake and economizer relief/exhaust outlet (class 1 air per Appendix A) configured as shown in the section below. The relief air (5000 cfm) is directed away from the intake at 2.5 /ls (500 fpm). (If the exhaust outlet distance above the roof is so small that air will be substantially deflected toward the intake, V should be assumed to be zero in Equation D1) Since the horizontal separation is zero, the minimum separation distance S is simply the vertical distance D in the figure below. Using the maximum value of 3000 cfm in equation D1, this distance must be:

$$S = 0.09 \sqrt{3000(\sqrt{5-500/400})} \\ = 4.9\text{ft}$$

This separation is required not because Class 1 air is unhealthy, but to ensure the air entering the outdoor air is primarily unventilated outdoor air. This example demonstrates that it is impractical to place the intake and discharge as shown without significant recirculation. Possible solutions: Move the intake to the opposite side of the unit; increase the discharge velocity to more than 4.5 m/s (900 fpm); or add a baffle between the intake and discharge to increase the "stretched string" separation distance.

APPENDIX E

RAIN ENTRAINMENT

Outdoor air intakes shall be protected from rain entrainment by use of one of the following:

- Louvers or mist-eliminators designed to limit water penetration to 3 mL per m² (0.01 oz per ft²) of free area when tested in accordance with AMCA Standard 500-1994 (15 minute test period).
- Rain hoods sized for no more than 5 m/s (1000 fpm) face velocity and tilted at least 45 degrees downward from the vertical.
- Louver or mist-eliminators in conjunction with a drain pan complying with Appendix F.

Exposed Internal insulation shall not be located within 0.5 m (1.5 ft) downstream of the air intake louver, eliminator, or screen.

[Water droplets entrained in HVAC system outdoor air inlets provide niches for microbial growth.]

These rain entrainment requirements may not be adequate to control entrainment of snow. Preheat coils with downstream filters or some other scheme may be needed to avoid snow build-up inside outdoor air intakes or on filters.

APPENDIX F

DRAINS AND DRAIN PANS

Drain pans located in supply air ducts, plenums, fan coil units, and other locations shall be sloped and trapped as required to meet the testing requirements in Appendix G. Drains located upstream of fans (those negatively pressurized relative to outdoors or those negatively pressurized to air in a mechanical equipment room) shall have traps having a depth and height differential between inlet and outlet equal to or greater than the fan design static pressure¹ or otherwise sufficient to maintain a water seal and allow complete pan drainage with fans on or off. Traps shall have a means of inspection to verify that the water seal has been maintained [such as an open or screened tee on the downstream end of the trap].¹

Condensate traps exhibit many failure modes that can impact on indoor air quality. Trap failures due to freeze-up, drying out, breakage, blockage, and/or improper installation can compromise the seal against air ingestion through the condensate drain line. Traps with insufficient height between the inlet and outlet on draw-through systems can cause the drain to back-up when the fan is on, possibly causing drain pan overflow or water droplet carryover into the duct system. The resulting moist surfaces can become sources of biological contamination. Seasonal variations, such as very dry or cold weather may adversely affect trap operation and condensate removal

Exception:

Secondary or auxiliary drain pans intended only for emergency overflow collection.

APPENDIX G

TESTING OF DRAINS AND DRAIN PANS

Drainage of pans under cooling coils, air washers, humidifiers, outdoor air intake plenums, and other duct or plenum mounted drain pans shall be tested to ensure proper slope and drainage to prevent conditions of water stagnation that result in microbial growth. Drainage shall be tested using the following procedure:

- Temporarily plug the drain and cover the entire pan with 13 mm (1/2 in.) water (or to the maximum allowed by the height of the pan)
- Start the fan if it is downstream of pan (in the draw through position). [The fan system must be in operation to test for improperly trapped drains that become air locked when the fan creates a negative pressure in the cold plenum.] Stop the fan if it is upstream of the pan (in the blow through position). [Fan operation assists in coil drainage of blow-through system so the pan must be tested with the fan off]
- Remove the temporary plug and observe the performance of the system. Drainage is considered acceptable when the pan drains within 3 minutes to leave puddles no more than 50 mm (2 in.) in diameter and no more than 3 mm (1/8 in.) deep.
- For draw-through systems, check to see that the water seal is maintained in the trap with the fan operating. Stop the fan and recheck the seal. The trap is considered acceptable if the water seal is maintained in the trap with the fan both OFF and ON. [Traps are not required by this Standard for blow-through systems since supply air leakage out of untrapped drains is not an IAQ issue. Traps can be provided to eliminate this air leakage for energy conservation purposes.]

Exception:

Secondary or auxiliary drain pans intended only for emergency overflow collection need not be tested.

APPENDIX H

MINIMUM AIR CLEANING AND FILTRATION

Mechanical systems that supply air to an occupied space through supply ductwork exceeding 3 m (10 ft) in length or through a humidifier, evaporative cooler, fin-tube heating coil, or cooling coil, shall be provided with particulate filters or air cleaners having a minimum efficiency of 60% when tested in accordance with ASHARE Standard 52.2 for 3 μ m particles. [This standard is pending approval. If it has not been published before this document, the requirement will reference 25-30% efficient filter as rated by ASHRAE Standard 52.1, Atmospheric Dust Spot Method.] Filters racks shall be designed to minimize the bypass of air around the filter media or filter cartridge frames when the fan is operating. [This section is intended to reduce the accumulation in duct systems and on duct components of dirt which may become a source of microbial growth or which may clog the system and affect airflow. It is not intended to address the possible use of cleaning return air to be used in lieu of outdoor air; which is covered in Section 6.4.]

The 60% filtration for 3 μ m particles is a minimum filtration requirement but some particulate accumulation within the ventilation system can still be expected over the life of the system. Where the system design can accommodate higher efficiency levels, efficiency levels of >65% for 1-3 μ m particles will improve indoor air quality with respect to particles and will reduce particulate accumulation in air distribution systems where cleaning is often difficult. Efficiency levels >65% for particles >0.3 μ m will be most effective where potentially large concentrations of respirable particles may occur.

APPENDIX I

INSULATION OF COLD SURFACES

Insulation shall be provided on the following ductwork and piping where located within the building envelope:

- Unlined cooling supply ductwork.

Exception:

- Cooling ducts located within air-conditioned spaces.
- In other than humid climates, cooling supply ductwork in return air plenums.

[The dew point of the return air will generally be less than the surface of the ductwork supplying air to the space. This exception does not apply to humid climates because condensation can occur due to infiltration of humid air into the ceiling plenum and during cool-down transients after moisture has built up in the space when the system was off. Note that insulation of supply ducts in plenums may be required by other codes or may be required to prevent excessive heat gain to supply air]

- Chilled water supply and return piping, domestic cold water piping where primary water supply can be expected to be below 13°C (55°F) during the cooling season.
- Domestic cold water piping where primary water supply can be expected to be below 13°C (55°F) during the cooling season.

The thickness of insulation shall be as required to prevent condensation on cold surfaces. Insulation that is subject to damage or reduction in thermal resistivity if wetted shall be enclosed with a vapor retarder sealed in accordance with manufacturer's recommendations to maintain the continuity of the barrier. Special coatings that inhibit condensation are an alternative to insulation if approved by the authority having jurisdiction.

[The purpose of this section is to prevent condensation, which may cause material damage or microbial growth indoor spaces. This section does not consider energy usage, which is covered by ASHRAE 90.1 - 1989.]

APPENDIX J

OUTDOOR AIR INTAKE CONTROL

Variable air volume systems (except those supplying 100% outdoor air) shall include controls and devices to measure outdoor airflow at the air handler and designed to maintain outdoor airflow not less than 90% of required levels over the expected supply air operating range. [A major consideration with VAV systems is that the negative pressure behind the outdoor air intake in the mixed air plenum will typically vary with supply air volume and at low supply volumes sufficient outdoor air flow may not be maintained if a fixed outdoor air intake damper position or even if a dedicated fixed minimum air intake is used. In most cases, an active outdoor air control system must be provided to ensure minimum rates are maintained.]

Acceptable air intake measuring devices include those that measure intake volume directly by measuring air velocity through an outdoor air duct or inlet of fixed area (e.g. duct mounted pilot or hot wire anemometer) or differential pressure across a fixed orifice (e.g. wide open damper or other non-adjustable duct mounted obstruction). If the system includes an outdoor air economizer; a separate minimum outdoor air damper may also be required in order to ensure adequate velocity across the intake for an adequate measurement. Note that a fixed speed outdoor air fan without control devices will not maintain rates within the required accuracy unless the fan curve is relatively steep with respect to changes in pressure and/or if the pressure changes in the mixing plenum are relatively small compared to the fan total pressure requirement. Using return air, outdoor air, and mixed air temperatures or CO₂ concentrations to measure air intake percentage is usually inaccurate when the outdoor and indoor values are close together and thus should not be used for this application unless it can be shown to meet the >90% accuracy requirement. Similarly, measuring outdoor air by taking the difference between supply and return air flow measurements will also seldom meet the >90% accuracy requirement due to cumulative errors in air flow measurement and the generally small outdoor air flow rate relative to supply and return air flow rates.

APPENDIX K

PRE-OCCUPANCY OPERATION

Ventilation systems shall be operated prior to the time any space served is expected to be occupied for a period of time determined in accordance with the requirement specified below and documented in the ventilation system design documentation (see Design Section 2.18).

Ventilation systems shall include either manual or automatic on/off controls that allow the fan system to operate whenever the spaces served are occupied. When thermostats used to control heating or cooling for systems that also supply required ventilation air include a manual switch accessible to untrained personnel that allows the fan to operate only upon calls for heating or cooling, controls shall be included to ensure the hourly average outdoor air supply rate and overall supply air rate are maintained. [Thermostats often have an "auto" position on the thermostat or subbase fan switch that cycles the fan only when heating or cooling is required. When the fan system also supplies ventilation outdoor air, this causes air supply to be discontinuous. Since many untrained people do not understand this, the switch is often placed in the "auto" position, resulting in inadequate ventilation.]

To comply with this section, the thermostat may be provided without an "auto " position, or with the control sequence in the "auto" position modified in a manner that either operates the fan on a continuous basis when the space is expected to be occupied or that activates a time or other device to ensure that hourly average supply air and outdoor air rates are maintained. Systems operated in this manner must be capable of supply more than minimum rates when the system is on in order to compensate for the time the system is allowed to cycle off.

In general, to comply with this section, programmable timeclock thermostats must be capable of operating the fan on the time schedule rather than simply changing setpoints on a time schedule. Note that many residential thermostats do not have this capability.

APPENDIX L

ISOLATION OF MAJOR CONSTRUCTION AREAS

Spaces of an occupied building that are undergoing major construction, renovation, or remedial work that become a temporary but significant source of indoor air contaminants (term "construction areas" hereinafter) shall be isolated from directly adjacent non-construction areas using temporary walls, plastic sheeting, or other vapor retarding barriers. These construction areas shall be maintained at a negative pressure relative to the adjacent non-construction areas by either exhausting construction areas and/or pressurizing adjacent areas. Recirculating return air ducts from construction area shall be temporarily capped and sealed to prevent the spread of contaminants to occupied areas served by the same system. Where particles are the only contaminant of concern, in lieu of capping off return ducts, return air shall be filtered as required to reduce particles with mean diameters less than 10 μm (PM10) to concentrations below those listed in table 5-1. For the purposes of this section, major construction areas within a building undergoing construction activities that require the temporary displacement of occupants for more than 48 hours, or new construction where spaces are newly completed (no former occupants). [This definition is intended to include major tenant work such as complete remodels plus major revisions that include demolishing or finishing drywall partitions, installation of new furnishings and carpeting. Minor touch-up painting and replacement of a small area of carpet are not considered significant contaminant sources.]

These requirements are also applicable to any other construction or installation of materials that generate significant contaminants. Contaminant concentrations within the construction zone itself are covered by applicable construction workplace standards from ACGIH, OSHA, or other local authority. Refer also to IAQ Guidelines for Occupied Buildings under Construction (SMACNA, 1995a).

APPENDIX M

PURGING OF MAJOR CONSTRUCTION AREAS

After construction is complete, major construction areas, as defined in Appendix L, shall be purged by supplying or exhausting no less than the design outdoor air rate required by Section 6 for a period of no less than 48 hours before occupancy. When spaces are exhausted, make-up air may be drawn from adjacent non-construction spaces rather than the outdoors. The requirements of Appendix L, pressurization relationships to adjacent spaces, shall apply until the 48-hour period is complete.

Exception: If it can be demonstrated that an alternative ventilation scheme can provide similar results and if approved by the authority having jurisdiction.

These procedures are also suitable for any other construction or installation of materials that generate significant contaminants. Depending on the new materials in the space and the rate at which they off-gas, a shorter or longer purge period may be required. When ambient conditions and the HVAC system design permit. The effectiveness of the purge, can be enhanced by ventilating spaces at rates far exceeding minimum ventilation rates.

End of Tab B-6

TAB B-7

CAMPUS ACCESSIBILITY

GENERAL OVERVIEW

Pima Community College (PCC) is committed to a universally designed campuses. While all institutions of higher education are legally obligated to comply with ADA accessibility standards, PCC seeks to maximize access in the built environment to encourage the full and equitable participation of all users. We consider this a great opportunity to build rich diverse communities and contribute to a welcoming campus culture.

Universal Design enhances the viability of the built environment by creating sustainable facilities and outdoor spaces that are usable by all people to the greatest extent possible without the need for modification or adaptation. Designing inclusively will reduce the need for retrofitting or making individual accommodations.

Design Professionals should take into consideration the full range of human diversity with respect not only to disability, but to language, gender, age and other differences or characteristics. Such attention to diversity in the design process is integral to creating socially responsible built environments and will result in design features that facilitate social interaction, community, identity and belonging. Design choices starting from initial site planning to the choice of hardscape and hardware products effect usability and impact equitable design. When spaces are designed “universally,” individuals are no longer disabled by their impairments or differences, and can experience things in the same ways as others.

Seven general principles guide Universal Design:

- **Equitable use:** The design is useful and marketable to people with diverse abilities.
- **Flexibility in use:** The design accommodates a wide range of preferences and abilities.
- **Simple and intuitive:** Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skill, or current concentration level.
- **Perceptible information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.
- **Tolerance for error:** The design minimizes hazards and the adverse consequences of accidental or unintended actions.
- **Low physical effort:** The design can be used efficiently and comfortably, and with a minimum of fatigue.
- **Size and space for approach and use:** Appropriate size and space is provided for approach, reach, manipulation and use, regardless of user’s body size, posture or mobility.

These design principles should inform the Design Professionals’ creative process from initial decisions regarding orientation of the building on the site and the layout of building amenities throughout the development of the design features, to the choices of products and furnishings.

To assist design professionals in applying Universal Design principles to projects at Pima Community College, the College has developed specific standards – PCC Accessibility Standards. **The PCC Accessibility Standards are specific measurements, equipment and/or arrangements of accessibility compliance that the College feels provide a more universally accessible condition than the minimum requirements outlined in the ANSI/ADAAG standards.** These standards are also used as reminders for important conditions that are not different than the standards, but often overlooked in design documentation.

PCC ACCESSIBILITY STANDARDS DESCRIPTION

The PCC Accessibility Standards are organized to coordinate with ADAAG Standards. The types of construction projects have been organized into three groups.

New Construction	N
Renovations	R
Historic Renovations	H

Applicability of these standards is categorized as either Mandatory (M) or Preferred (P).

TYPES OF PROJECTS

- **New Construction**

New construction projects are defined as those projects involving the design and construction of new facilities and outdoor spaces where building and site development are unencumbered by pre-existing building or site accessibility constraints. Additions to existing buildings (inclusive of fully attached to minimally connected) are also considered to be New Construction Projects in regards to building accessibility, and, if provided with new entrances from the exterior, also in regards to site accessibility. Individual evaluation of additions to existing buildings should be undertaken early in the design process to outline the extent of existing building and/or site accessibility compliance that will be necessary.

- **Renovations**

Renovation projects are defined as projects involving the renovation/alternation of a portion of an existing building that affects, or could affect, the usability. A renovation that could affect the usability of, or access to, an area of a facility that contains a primary function shall also include improvements to the path of travel to the renovated/remodeled area and the restrooms/drinking fountains serving that area so that they are readily accessible to, and usable by, individuals with disabilities, including individuals who use wheelchairs. These improvements shall be included to the maximum extent feasible, unless the cost and scope of such renovations exceed 20% of the cost of the renovation to the primary function area. Individual evaluation of whether or not such improvements are required should be undertaken early in the design process to outline the extent of existing building and/or site accessibility compliance that will be necessary. Please refer to 2010 ADA Standards Section 202.1-4.

- **Historic Renovations**

Projects involving buildings/sites on the National Register of Historic Places must comply with the PCC Accessibility Standards in such a way that impact is minimized and a building/site's historic integrity and character defining features are maintained. The determination of a building/site's historical integrity and character defining features shall be made by an individual meeting the Secretary of the Interior's Professional Qualification Standards for Historic Preservation.

Due to the potential range of existing conditions, defining features and significant elements, and the ability of an historic renovation project to address such conditions, it is imperative that each project involving a qualified historic building or site undergo an evaluation early in the design process to outline the scope of accessibility compliance which can be achieved, and explore alternative design options or methods to provide programmatic access required of public entities. Please refer to ADA Standards Section 202.5.

COMPLIANCE REQUIREMENTS

All construction projects, new, renovation and historic renovation, must comply with accessibility requirements, including PCC Accessibility Standards.

Accessibility codes, guidelines and standards with which the project shall comply are described in the Design Professional’s “Scope of Services” Exhibit to the agreement. (Consult with **Facilities Planning** if this document is not available to you.) Additionally, there are PCC Accessibility Standards that are more specific, restrictive and/or descriptive than the above referenced requirements. These are described in the following pages of this DSS tab. Project compliance expectations are included.

Compliance Requirements Key:

Mandatory – M	Compliance with Mandatory PCC Accessibility Standards is required.
Preferred – P	Compliance with Preferred PCC Accessibility Standards is encouraged, but to achieve accessibility as part of a renovation project the College recognizes there may be challenges such as: <ul style="list-style-type: none"> • Conditions physically beyond the limits of the renovation or path of travel requirements. • Spatial/structural/technical conditions which make accessibility infeasible to achieve. • Conditions that cannot be addressed within a defined project scope or budget.

SECTION 1 – BUILDING BLOCKS

N R H Reach Ranges

M	M	M	Except as outlined in this section, the <i>operable portion</i> of building equipment and controls (such as electrical switches, fire alarm pull stations, above work surface telecommunications outlets, thermostats, elevator call buttons, etc.) shall be located 42” max. above the finished floor. For information on reach ranges for equipment in rest rooms, toilet rooms, and bathing rooms, see SECTION 4 - PLUMBING ELEMENTS AND FACILITIES.
M	M	M	Where devices have more than one operable mechanism, and are more than 6” apart (such as a tall, rectangular shaped fire extinguisher cabinet), a maximum height of 48” is allowed for the higher mechanism to allow the cabinet to be mounted on the wall at a desirable height above finished floor.
M	M	M	Door access card swipes and keypads shall be centered at 38” above finished floor. When a pedestal is used at entrances, use a PCC specific ADO/keyless access pedestal.
M	M	M	Control plates for automatic door openers shall be centered at 33” above the adjacent finished surface.

SECTION 2 – ACCESSIBLE ROUTES

N R H During Construction

M	M	M	Renovations that temporarily eliminate building-wide access features (i.e. change of building entrance, access through building, accessible restrooms, elevators, etc.) shall provide comparable, temporary replacements, including temporary directional signage, for said features. Temporary directional signage placement and wording to be reviewed by PCC Physical Access Coordinator .
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M	M	M	Construction fencing/staging, earthwork and temporary drainage conditions shall be designed to maintain existing accessible routes or alternative, temporary accessible routes, and directional signage shall be provided.
M	M	P	Temporary ramps used during construction shall have ADA compliant handrails, landings and edge protection, and shall attempt to achieve a maximum slope of 1:16.

N R H Accessible Path of Travel - Exterior

M	M	M	Minimum sidewalk width shall be 6' (72"); wider as required on major routes.
M	M	M	Connect to an accessible campus route at all pedestrian access points to parking structures and other parking facilities.

N R H Surface Materials

M	M	M	Decorative ground surface treatments (i.e. exposed aggregate concrete, unit pavers, stone paving, etc.) shall provide a surface free of horizontal gaps or vertical transitions in excess of ½" inch. <ul style="list-style-type: none"> • Provide adequate sealant at expansion joints to minimize level change • Other than joint between building slab and paving, avoid expansion and control joints at maneuvering areas in front of doors • Limit aggregate size in exposed aggregate concrete to ¼" maximum NOTE: Decorative larger aggregate and stonework can be used in areas that are not walking surfaces.
M	M	M	Granular surface materials used to create exterior paths of travel shall include a stabilizer to provide a surface that is usable during all weather conditions. Granular surface materials may not be used on path of travel surfaces with a slope steeper than 1:20.
M	M	M	Changes in surface material, both inside and exterior, shall be provided with a durable transition that will meet the change in elevation height requirement throughout the life of the building/space.
M	M	M	See "Curb Ramps" for information on detectable warning surfaces.

N R H Accessible Routes - Interior

M	M	M	Maintain ADA compliant clear path of travel in areas with movable furniture.
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N R H Queueing

M	M	M	Provide clearances and turning radii in compliance with ADA accessible route requirements for all temporary and permanent line stanchions. Stanchion bases cannot reduce the clear width of the queue to less than 32".
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N R H Bicycle Parking Adjacent to Accessible Routes

M	M	M	Locate bicycle-parking racks so that parked bicycles do not encroach in the accessible path of travel (POT). Allow for bicycles parked with front wheel secured to hoop. Install bicycle rack 24" from POT if parallel, and 48" from POT if perpendicular.
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N R H Building Entrances

M	M	M	The main entrance of a building shall be universally accessible via a single route. NOTE: Some buildings might have more than one main entrance.
M	P	P	All building entrances shall be accessible, including "employee" entrances, or entrances other than the "main" entrance.

N	R	H	Doors and Doorways and Glazing
M	M	M	Kick plates shall be provided on non-latching doors with push-pull hardware.
M	M	M	<p>Frameless Glass Doors – Detail to provide for the following:</p> <ul style="list-style-type: none"> Decorative contrast at latch-side edge of the door, and on adjacent edge of glass wall or panel An automatic door operator. For banks of frameless glass doors, an automatic door operator will be required at only one door <p>When a floor pivot is used, the required clear width shall be provided when door is in any position. This may require a wider door. Provide a doorstop when it is necessary to prevent the door from opening past 90 degrees.</p>
M	M	M	All latching door hardware must be lever handle type.
M	M	M	Doors shall not exceed 5 lb. max opening force. This is applicable at both interior and exterior doors unless an ADO is provided. Consider this requirement when planning oversize doors.
M	M	M	Door pulls must be usable at standard door handle height (38” – 42”).
M	M	M	<p>The following shall not be used:</p> <ul style="list-style-type: none"> Revolving doors Sliding glass doors with a bottom track (occurring on an accessible route) <p>Pocket doors are not desirable.</p>
M	M	M	Provide information on non-standard door pulls for review and approval prior to inclusion in contract documents. Example: Pulls that extend into lower 34” of door on the push side, which can cause problems for wheelchair users.
M	M	M	At glass wall sections that go to the floor provide a decorative contrast or gradient treatment somewhere within 36” and 48” above finished floor to make it easier for the visually impaired to discern the difference between a plane of glass and an opening. This applies to sliding glass door sections as well.

N	R	H	Automatic Door Operators
M	M	M	Automatic door openers shall be installed at each main entrance to a building. Take special care at courtyard buildings with multiple exterior doors so that all building areas can be accessed by a door with an ADO (this applies at all building levels). See 087113 for ADO product information. See Tab B-3 for bollard mounted installation. In courtyard buildings, ADO’s may be necessary at other essential exterior doors such as classrooms and restrooms.
M	M	M	Electrical infrastructure for automatic door operators shall be provided at all alternate accessible building entries.
M	M	M	Locate ADO’s per Figure 1. For guidance on horizontal placement of control plates for Automatic Door Operators refer to diagrams C12-D1 thru C12-D6. Design Professional shall clearly note ADO control locations on Design Development and Construction Document architectural floor plans for review by PCC Planning Department, and for coordination with Amer-X keyless access interface. For vertical placement of control plate for Automatic Door Operators, refer to Section 1 – Building Blocks, Reach Ranges.
M	M	M	Use the PCC specific pedestal for ADO button and keyless access equipment where an exterior wall location is not available.
M	M	M	Make provisions for incorporating Automatic Door Operator in design of door head frame.

N	R	H	Ramps
M	M	P	Where changes in elevation are encountered (including courtyards and open spaces), provide a universally accessible design that addresses the elevation change, rather than providing separate stairs and ramp.

M	M	M	Where space and grades allow, sloped sidewalks (slope 1:20 or flatter) shall be used in lieu of ramps to overcome changes in elevation.
M	P	P	When used, ramps (defined as anything steeper than a 1:20 slope) shall have a maximum 1:16 slope.
N	R	H	Curb Ramps
M	M	M	Curb ramp slopes shall be 1:12.
M	M	M	Concrete aprons shall be provided at the bottom of curb ramps.
M	M	M	Curb ramps within sidewalks (parallel to the path of travel) shall be provided with a 1:16 slope.
M	M	M	The College standard for detectable warning surface is TekWay Dome-Tiles manufactured by StrongGo LLC (Phone 520-547-3510, Fax 520-547-3515, Web stronggo.com) <u>or equal</u> . The standard color is Federal Yellow. The depth of detectable warning surface in the direction of travel shall not exceed 24".

N	R	H	Elevators and Lifts (see also Section 14 00 00 - Conveying Equipment)
M	M	M	Platform lifts shall not be used.

SECTION 3 – GENERAL SITE AND BILDING ELEMENTS

N	R	H	Parking Spaces
M	M	M	All accessible parking spaces shall be a universal size of 132" wide with a min. 60" wide access aisle. The 60" aisle can be shared between two spaces.

SECTION 4 – PLUMBING ELEMENTS AND FACILITIES

N	R	H	Parking Spaces
M	M	M	Vestibule (i.e. doors in series) entries into rest rooms are not permitted.
M	M	P	All gender-neutral restrooms shall be accessible for the purposes of privacy and/or assisted use. Locate all gender-neutral restrooms in the same area of the building as gendered restroom blocks (multi-stall restrooms).
M	P	P	Accessible gender-neutral rest room(s) shall not be used as a substitute for providing accessibility to multi-stall rest rooms.

N	R	H	Toilet and Restrooms
M	M	P	Single occupant public/employee restrooms shall be fully accessible.
M	M	P	Private toilet rooms for employees, i.e., only accessed through a private office, shall be designed to allow accessible toilet room requirements to be added in the future. Approach, entry, and exit shall be fully accessible. Provide 5' turning radius within room. Provide blocking for future grab bar installation.

N	R	H	Water Closets and Toilet Compartments
M	M	M	A side approach toilet shall be provided. Where possible, provide an "end stall design" where it is possible to have a 5' turning radius located completely within the compartment. Where a restroom has more than 1 wheelchair accessible stall, provide 1 for left side approach and 1 for right side approach.
M	M	M	Provide vertical grab bar at water closets in wheelchair accessible, accessible ambulatory stalls and accessible single use bathrooms/restrooms. Comply with ANSI standards for size and placement of vertical grab bar.

Pima Community College
Facilities Guidelines and Specification Standards

M	M	M	When Ambulatory stalls are provided, specify an accessible height water closet, 17" - 19" to top of seat. Ambulatory stall width: 35" to 37" interior dimension measured to the partition/walls. Center the toilet in the stall or 17-19 inches from the wall. All other toilet accessories and installation heights are the same as those required for accessible toilet rooms / stalls.
M	M	M	Flush valves for toilets shall be located at the open approach side of the toilet.
M	M	M	Toilet Paper Dispensers shall be surface mount, PCC standard (OFCl) continuous feed compact side by side double roll type (10Wx6Dx7H) and shall be located so that: <ul style="list-style-type: none"> The centerline of the dispenser is located 7" from the front edge of the toilet bowl. There is 2 inches clear space below the grab bar to the top of dispenser. NOTE: Quad/Four Roll dispenser types or jumbo single roll types are NOT allowed in wheelchair accessible stalls, ambulatory stalls or accessible single occupant/all gender-neutral toilet rooms.
M	M	M	Door pulls shall be provided on both sides of doors to accessible and ambulatory toilet compartments. Outward swinging stall doors require 2 additional pulls on the interior side of door. Pulls must be operable with a closed fist and mounted horizontally; 5" minimum wide opening, with 1 ¼" clearance. Locate one pull adjacent to, and at the same height as the door latch. Locate the second pull near the door hinge at 36" AFF and 8 inches away from the hinge.
M	M	M	Provide a coat hook at 42" max above the floor in the accessible and ambulatory toilet compartment. Locate in the center of the door (and not above the latch) or locate on a side wall or partition in end of row stalls, away from the side grab bar so hanging items will not conflict with grab bar clearance.
M	M	M	Latching mechanism for accessible toilet compartment doors shall be operable with a closed fist. Large paddle type preferred.
M	P	P	Provide full length framed mirror (CFCl) in multi-stall restrooms and accessible single occupant / all gender-neutral toilet rooms. In considering best wall location for viewing, avoid sight lines into the room. Need to check if we want this

N R H Lavatories and Sinks

M	M	M	Provide 36" width minimum per lavatory, and position lavatory to allow adequate space for soap dispensers and paper towel dispensers on side return walls.
M	M	M	Soap dispensers shall be PCC standard surface mounted (OFCl) and shall be operable with one hand. Align dispenser with the top of backsplash or with the sink splash/bottom edge of mirror at wall-hung sinks to maintain 4 inches clear space beneath for access. Provide min. (1) dispenser on wall where there is a sidewall adjacent to sink. Locate the dispenser above the counter area, with operable mechanism at 42" max above the finished floor and at 6 inches away from the front edge of counter. Under counter mounted soap dispensers and pump type dispensers are not allowable unless motion operated.
M	M	M	A 28" knee clearance shall be provided under accessible wall hung sinks and countertop sinks. "Extended" wall hung sinks (those with a deep front-to-back dimension) shall not be used to achieve the 28" knee clearance. Design of built in countertop vanities requires special attention to ensure knee clearance is met.
M	M	M	Sink faucets shall be automatic, wrist blade, lever-operated, or "push-on" type with delayed shut off to permit single hand operation. In conflict with 22 40 00
M	M	M	Adaptable sinks with accessible cabinetry (such as sinks found in employee kitchen areas, laboratories, dwelling units, etc.) shall be provided with a finished flooring surface in the under-cabinet space. The cabinet doors shall be provided with an integral toe kick at sinks with 36 inch or wider base cabinet. At smaller base cabinets with single bowl sinks - in lieu of integral toe kicks, provide 180-degree hinges to allow the doors to swing back against the cabinet face. A 28" H knee clearance shall be provided at the open area below the countertop apron at adaptable sink areas without cabinet doors.
M	M	M	Paper towel dispensers shall be PCC Standard surface mount (OFCl) and located so that operating mechanism is 42" max above the finished floor. Dispensers may not overlap clear floor space at sinks

			or create a non-cane detectable protrusion along the path of travel.
M	M	M	Hand dryers with bottom air outlet shall be located so that operating mechanism is at 40" above the finished floor. Hand dryers that hands are inserted into, shall be located so that top of unit is 36" above the finished floor. Do we want hand dryers?
M	M	M	Trash receptacles shall be PCC standard types. (OFOI). Indicate receptacle locations to ensure trashcans do not impede maneuverable clearance areas at doors. Maintain clear floor space requirements. Under-counter trash receptacles with a countertop cutout are acceptable if clear floor space is maintained

N R H Baby Changing Stations

M	M	M	Project specific; confirm with PCC Planning Department. When required, baby-changing tables shall be located in main public restroom blocks and accessible single occupant / all gender neutral toilet rooms. Install so that at the open and lowered position, surface is 34" above the floor. In the closed position, the station cannot overlap required floor spaces at fixtures or maneuvering clearances. Stations are not permitted within a water closet stall but can be located in single toilet rooms if maneuvering clearance space is maintained.
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N R H Shower Compartments

M	M	M	<p>In non-residential conditions, accessible showers shall:</p> <ul style="list-style-type: none"> • Be a 36"x36" transfer-type entry with a padded, fold down bench (with integral support legs) that extends the full width of the stall and is located on the wall opposite the controls/shower head • Have grab bars installed in compliance with ANSI requirements <p>For transfer type, shower ½" high threshold is allowable: beveled, rounded or vertical. In existing buildings where a ½" high threshold would disturb structural reinforcement of the floor slab, a 2" high threshold is allowable. Shower curtain can encroach on 36" shower dimension to allow it to be located on the inside of the threshold. Allow 3" maximum from edge of bench to curtain.</p> <p>Locate fire alarm device(s) in bathrooms so that it is visible from all locations within room. Take particular care in locating device so that it can be seen from inside shower stalls (for hearing impaired). If general room device cannot be seen from inside a shower, provide a visual fire alarm device in shower drying area.</p>
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SECTION 5 – COMMUNICATION ELEMENTS AND FEATURES

N R H Assisted Listening Systems

M	M	M	Assisted listening system are required where amplification is provided. Consult with the PCC ADR Office on the appropriate type of system for the building/space. Preference is to use looping in highly public venues. Ensure appropriate signage is added to the signage package for the space.
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N R H Emergency "Blue Light" Phones

M	M	M	<p>Access shall be provided to Emergency "Blue Light" Phones. Specifically, the following shall be provided (see also Diagram C12-D7):</p> <ul style="list-style-type: none"> • Accessible approach, with access from multiple directions • Ample accessible clear ground space in front of the operable portion of the phone. Install unit at grade, not on a pad, to maintain operable mechanisms within allowable reach range
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N R H Signage

M	M	M	For any signage, interior or exterior, shall reviewed and approved PCC Planning Department.
M	M	M	The 'active' wheelchair symbol (wheelchair appearing to be in motion) is to be used wherever a wheelchair symbol is included.
M	M	M	PCC Planning Department shall review all signage verbiage. For example, PCC does not include the word 'handicap' on any signage.

SECTION 6 – SPECIAL ROOMS AND SPACES

N R H Auditorium, Tiered Classrooms, and Assembly Areas

M	P	P	In auditoriums, tiered classrooms and assembly areas, wheelchair accessible seating and companion seats shall be provided in a variety of locations throughout the seating area.
M	P	P	Per ADA Guidelines, locate companion seats to provide shoulder-to-shoulder alignment (front to back) with adjacent wheelchair space, which is measured to be 36" from the front of the wheelchair space.
M	P	P	Wheelchair access shall be incorporated in the primary access route to the stage/ teaching station areas.
M	P	P	In fixed seating situations, aisle seats with fold up arms for use by disabled shall be provided and identified.
M	M	P	When fixed seating is provided with tablet arms, consult with Facilities Planning Department for accessible equivalent seating alternatives. A table area or areas with movable seating may be required.

N R H Kitchens and Kitchenettes

M	M	P	Employee kitchens and break rooms must be accessible. Provide work surface 34" above finished floor and an accessible sink with accessible cabinetry or open space below the sink. Finished flooring surface shall be provided in the under-cabinet space. The cabinet doors shall be provided with an integral toe kick at sinks with 36 inch or wider base cabinet. At smaller base cabinets with single bowl sinks - in lieu of integral toe kicks, provide 180-degree hinges to allow the doors to swing back against the cabinet face. <ul style="list-style-type: none"> • A 28" H knee clearance shall be provided at the open area below the countertop apron at sink areas without cabinet doors.
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N R H Academic Laboratories

M	M	M	Academic (teaching) laboratories shall be accessible. Provide accommodations at 5% of workstations (minimum of 1 station) per lab. The accessible work station(s) shall provide, or have the capacity to provide, those elements of laboratory furnishings and equipment specific to the type of teaching expected to be conducted in the laboratory. Use of adjustable modular lab furnishings provide the best adaptability for users of all heights, and for those who use wheelchairs.
M	M	M	Accessible work stations shall include: <ul style="list-style-type: none"> • A bench space, either adjustable in height or a maximum of 32" high at the work station, and 34" high at a sink, with 29" minimum clearance below • Access to an ADA compliant sink with single action lever controls or wrist blade handles faucet controls • Lab gases and power outlets located on the side of the bench or within 18" of the front edge of the bench with single action lever controls or wrist blade handles • Storage facilities (for lab equipment/materials to be utilized by students in the lab) within ADA reach ranges
M	M	M	Where academic laboratories utilize fume hoods, provide 5% of total, or at least one, accessible fume hood with:

			<ul style="list-style-type: none"> • A 32" high (maximum) work surface with 29" clearance below • Gas/services within the hood located on the side of the hood or within 18" of the front edge of the hood, with single action lever controls or wrist blade handles
M	M	M	Eyewashes/safety showers shall be independently accessible and operable by a wheelchair user.
M	M	M	Where non-laboratory teaching amenities (writing surfaces, lecture areas, etc.) are provided within academic laboratories, 5%, or at least one, shall be accessible.
M	M	M	Specific purpose teaching facilities (such as tissue culture rooms) shall provide a wheelchair accessible space with: <ul style="list-style-type: none"> • A 5' diameter turning radius within the room • A bench space 2'-6" long with a 32" height (maximum) and a minimum 29" clear space below (for a depth of 9" plus toe space beyond)

N R H Academic Laboratories

M	P	P	Research laboratories shall have provisions for wheelchair accessibility. The accessible work station(s) shall provide, or have the capacity to provide, those elements of laboratory furnishings and equipment specific to the type of research expected to be conducted in the laboratory. Use of adjustable modular lab furnishings provide the best adaptability for users of all heights and those who use wheelchairs.
M	P	P	Individual research laboratory rooms assigned to specific employees are considered employee work areas. For employee work areas, basic access is required for approach, entry, and exit.
M	M	P	Research laboratory rooms with open assignment workstations/bench space shall be provided with 5% of total, or at least one accessible workstation with: <ul style="list-style-type: none"> • A bench space, either adjustable in height or a maximum of 32" high at work station and 34" high at sink, with 29" minimum clearance below • An accessible sink with faucet controls located on the side (not rear) with single action lever control or wrist blade handles faucet controls • Lab gases and power outlets located on the side of the bench or within 18" of the front edge of the bench with single action lever controls or wrist blade handles. • Aisles 42"-48" wide for accessible bench space/hoods • Storage facilities within ADA reach ranges
M	M	P	Shared, specific purpose research laboratory rooms (such as tissue culture rooms) in open assignment research laboratories shall have at least one wheelchair accessible workstation/hood with: <ul style="list-style-type: none"> • A 5' diameter turning radius within the room • A bench space 2'-6" long by 32" high (maximum), and a minimum 29" clear space below
M	M	P	For shared fume hoods in open assignment research laboratories, provide 5%, or least one accessible fume hood(s) with: <ul style="list-style-type: none"> • A 32" high (maximum) work surface and a minimum 29" clearance below • Gas/services within the hood located on the side of the hood or within 18" of the front edge of the hood, with single action lever controls or wrist blade handles

SECTION 7 – FURNISHINGS AND EQUIPMENT

N R H General

M	M	M	When loose furniture may be moved into the path of travel, 42" - 48" aisles for clearance / maneuvering shall be provided.
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N R H Seating at Tables, Counters, and Work Surfaces

M	M	M	A minimum of 5% of work/dining surfaces (computer tables, dining tables, study carrels, etc.) used for extended periods of time by transient populations shall be accessible. Surfaces shall be a maximum of
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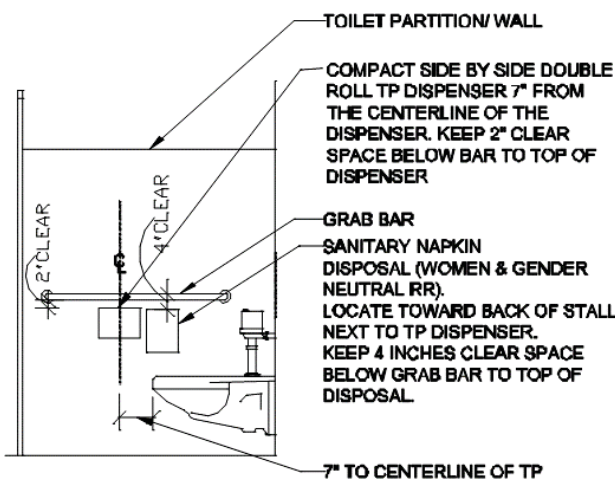
			32" above finished floor to the top, and provide a minimum clear height of 28" below the surface. The clear height shall extend a minimum of 9" back from front edge of the surface with a vertical clearance wheelchair footrests beyond.
M	M	M	Accessible height service / reception counters shall be provided at the primary queuing point or staffing location, not at a secondary location. Counter height shall be a maximum of 34" above finished floor.

N R H Audio Visual Technology, Screens, Monitors and Graphics/Artwork

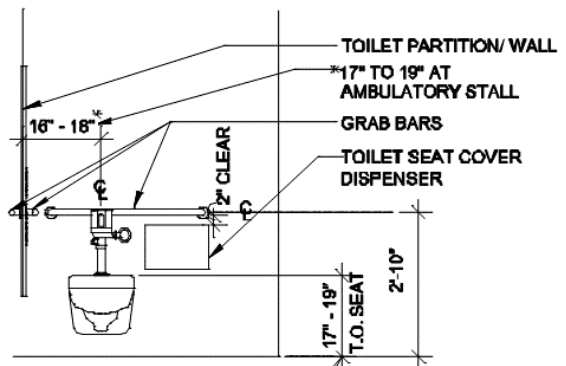
M	M	M	<p>Mounting heights are required to meet the same criteria as other objects within paths of travel and may not create a non-cane detectable protrusion (may not protrude more than 4 inches from the wall surface when mounted between 27 inches and 80 inches from the floor). If an object protrudes more than 4 inches from wall, provide a cane detection warning, such as:</p> <ul style="list-style-type: none"> • Placing a narrow cabinet or similar item below the object; providing a recessed niche to inset the object at the required depth, or framing a "pop out" (required depth x 27" AFF) at the lower section of wall below the object. • All switch/controls or operable mechanisms shall be installed at 42" AFF.
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Accessible Toilets/Ambulatory Stalls – Additional Information:

- Accessible toilet accessories installation heights, raised toilet height, interior door pulls and coat hooks are also required at all ambulatory stalls.
- Locate centerline of toilet 16" to 18" from sidewall (17" to 19" at ambulatory stalls).
- Toilet flush control on open side of stall. Toilet height seat 17-19" to top of seat.
- Outward swinging stall doors require two additional pulls (mounted horizontally) on the interior side of door: (1) pull adjacent to and at same height as the door latch, and (1) pull near the door hinge at 36" AFF and 8 inches away from the hinge. Install one coat hook on inside of door at 42" AFF.
- TP dispenser (OFCl): surface mounted compact side by side double roll type, 10W x 6D x 7H. Install dispenser 7" from the front edge of bowl to the centerline of dispenser. Keep two inches clear space below the grab bar to the top of dispenser.
- Paper towel dispensers (OFCl): install with operable mechanism/paddle at 42" AFF max. Dispensers may not overlap required clear floor space at sinks or create a non-cane detectable protrusion along the path of travel.
- Soap dispensers (OFCl): install with operable mechanism/paddle at 42" AFF max/or align with the top of back-splash at vanities or with the sink splash/bottom of mirror at wall hung sinks. Provide minimum (1) dispenser on wall where there is a sidewall adjacent to sink. Locate the dispenser **above the counter area** with operable mechanism at 42" max above the finished floor and at 6 inches away from the front edge of counter.
- Sanitary napkin disposal (CFCl): a surface mounted sanitary napkin disposal is required in women's stalls and in all gender-neutral restrooms. Install towards the back of stall next to TP dispenser. Keep 4 inches clear space below the grab bar to the top of disposal.
- Full length framed mirror (CFCl): required in all gender neutral and multi-stall restrooms. Consider best wall location and to avoid sight lines into the room.
- 1Trash receptacles (OFCl): Plan receptacle locations during design. Do not locate within the maneuverable clearance areas at doors. Maintain accessible clear floor space requirements.
- Toilet seat cover dispensers (CFCl): Project specific; confirm with PD&C PM - surface mounted, locate on the toilet wall, 2 inches below the grab bar (align with the end of bar) or locate within the open wall space next to the grab bar at 32" AFF to top of dispenser.
- Baby changing stations (CFCl): Project specific; confirm with PD&C PM - surface mounted, 34" AFF at open/lowered position. In the closed position, the station cannot overlap required floor spaces at fixtures or maneuvering clearances. Baby changing stations are not permitted inside accessible stalls but can be located in single toilet rooms if the maneuvering clearance space is maintained.

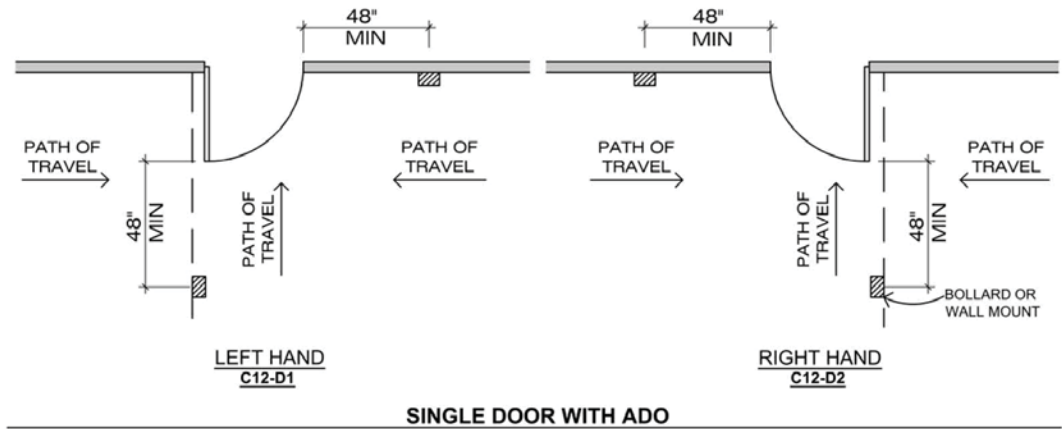


ACCESSIBLE TOILET SIDE WALL

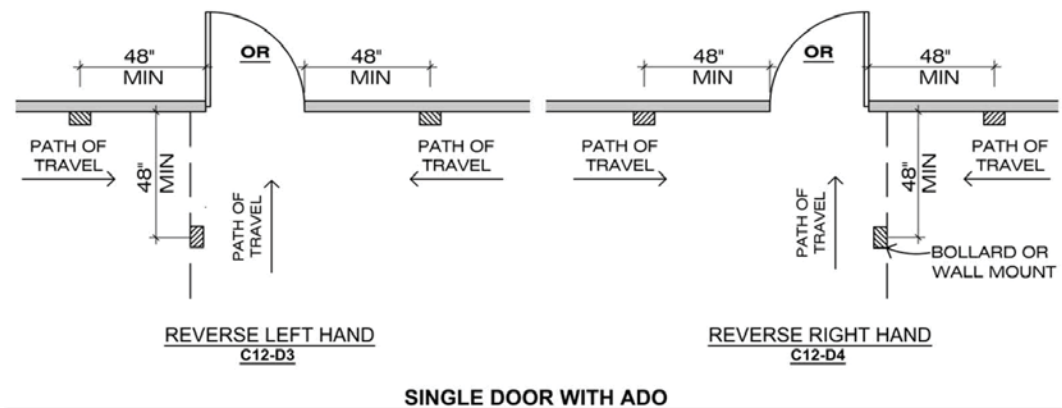


ACCESSIBLE TOILET BACK WALL

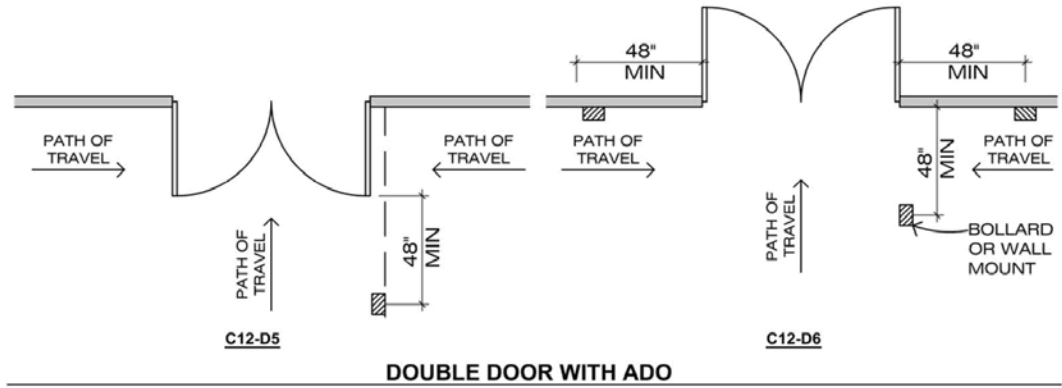
TYPICAL ADO LOCATIONS



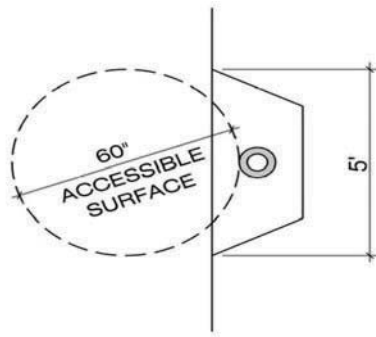
SINGLE DOOR WITH ADO



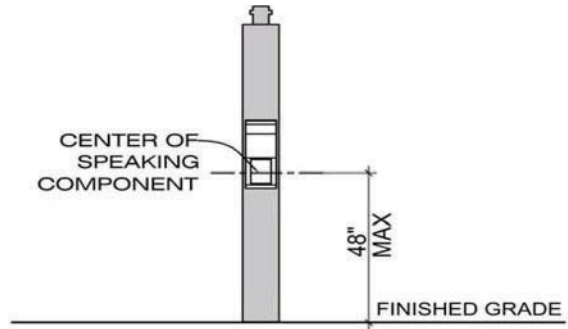
SINGLE DOOR WITH ADO



DOUBLE DOOR WITH ADO



PLAN
C12-D7



ELEVATION
C12-D8

BLUE LIGHT PHONE PEDESTAL

End of Tab B-7

TAB B-8

CAMPUS SUSTAINABILITY

Pima Community College is committed to a leadership role in promoting sustainability on our campuses and in our design and construction practices.

End of Tab B-8

TAB B-9

ALL GENDER RESTROOM REQUIREMENTS

The College is committed to designating and maintaining a minimum of one all gender restroom in as many of its buildings as reasonably feasible. Therefore, the following criteria should be followed:

WHERE REQUIRED

- New Buildings - A minimum of one all gender (AG) restroom should be provided in each new building.
- Building Expansions - Major building expansions should include an AG restroom unless it is determined that the existing facility has a restroom that can be designated or converted as part of the project scope.
- Renovations - Renovation projects are defined as those projects involving the alternation of a portion of an existing building. Renovations range from simple aesthetic improvements to complex physical reconfigurations and systems' replacement. Due to the potential range of existing conditions – and the ability of a renovation project to address such conditions – it is incumbent that each renovation project undergoes an evaluation early in the design process to outline the scope of compliance which can be achieved.
- In general, for minor renovations or room specific renovations, requirements for AG restrooms will not be part of the project scope. For projects where major bathroom renovations are part of the scope, inclusion of one AG restroom, if not already extant, should be included. For major renovation projects affecting entire floors or buildings AG restrooms should be provided if reasonably feasible.
- Where existing facilities are renovated, converted or re-designated, the all gender restroom may contain multiple stalls.

DESIGN CRITERIA

- In new construction, each AG restroom shall meet handicap accessibility criteria. Accessible AG restroom(s) shall not be used as a substitute for providing accessibility to multi-stall rest rooms.
- In new construction, each AG restroom shall include one diaper-changing table in addition to standard plumbing fixtures/equipment.
- Refer to other sections of this DSS as applicable for plumbing and bathroom accessory criteria.
- Each single occupant AG restroom shall have a lockset that is operated from the interior and indicates if the AG restroom is occupied.
- In Multi-stall AG restrooms, all toilet and urinal fixtures shall be enclosed in toilet partitions that have privacy latches.
- The plumbing fixtures in AG restrooms shall count towards the total fixture counts required by code.
- All AG restrooms will be signed as FAMILY RESTROOM.

TAB B-10

LACTATION ROOM REQUIRMENTS

As required by the Affordable Care Act of 2010, Pima Community College is committed to designating and maintaining a minimum of one lactation room in as many of its buildings as is reasonably feasible. Therefore, the following criteria should be followed:

- **WHERE REQUIRED**

- **New Buildings**

A minimum of one lactation room should be provided in each new building.

- **Building Expansions**

Major building expansions should include a lactation room unless it is determined that the existing facility has a lactation room that can be accessed from the building expansion.

- **Renovations**

Renovation projects are defined as those projects involving the alteration of a portion of an existing building. Renovations range from simple aesthetic improvements to complex physical reconfigurations and systems' replacement. Due to the potential range of existing conditions - and the ability of a renovation project to address such conditions - it is incumbent that each renovation project undergoes an evaluation early in the design process to outline the scope of compliance which can be achieved.

In general, for minor renovations or room specific renovations, requirements for a lactation room will not be part of the project scope. For projects where major renovations are part of the scope, inclusion of one lactation room, if not already existing, should be included. For major renovation projects affecting entire floors or buildings, a lactation room should be provided if reasonably feasible.

- **DESIGN CRITERIA**

- **Summary**

Mothers returning to the College after childbirth are not only driven to provide for their new babies but also to be productive students and employees. Providing a lactation room at the College helps these students and employees achieve both of these goals. Following the design guidelines given here will yield a lactation room that is easy to use and offers comfort and respect to mothers.

- **Room Requirements**

Several times a day, a nursing mother needs to retreat to a quiet, closed room to collect expressed milk. She needs a calm restful environment with all the required elements for an efficient and safe pumping session.

A typical pumping session includes changing clothes, sitting at a desk in front of a pump for 15 to 30 minutes, placing milk in storage bottles, washing bottles and pump parts and packing them away until the next pumping session, redressing and returning to work. At the end of the session, the pumped milk must be stored in a refrigerator or cooler. In an eight-hour workday two or three pumping sessions are normal.

The lactation room shall include actual and perceived privacy. Pumps can be noisy so sound dampening shall be provided to achieve auditory comfort in and around the space.

The lactation room shall provide a lockable door; a work surface and chair; a small utility-type sink; storage for cleaning supplies and paper towels; a thermostat for the HVAC system; electrical outlets, telephone service and network connections to increase worker safety and productivity. Meet accessibility guidelines for all the features of the room.

- **Size**
Provide a minimum footprint of 7 feet by 7 feet as it will allow for a 5-foot radius circle with 24-inch deep counters on two walls. Other configurations may be acceptable as well.
- **Location**
Locate the lactation room in a safe area accessible to all.
- **Privacy**
Install a user-operated indicator deadbolt for privacy that will display an "occupied" message to discourage interruptions.
- **Signage**
The lactation room should be signed as "Family Room" and should include the International symbol for Breastfeeding.
- **Sound Privacy**
Extend walls should reach up to the structure above to minimize sound transmission over them into adjacent spaces. Install sound attenuation in walls to minimize sound transmission. Install fabric panels, curtains, carpeting, or other sound-dampening materials to minimize echoes.
- **Chair**
Provide a task chair suitable for a workstation with seat, back, armrest, lumbar, tension, and height adjustments. The chair shall have casters to allow the user freedom of movement when hands are occupied with bottles of milk and pump parts.
- **Table/Counter**
Provide a minimum 20-inch deep by 30-inch wide plastic laminate or solid work surface for the pump and bottles to rest on in front of the task chair. Provide a 30-inch wide clear knee space beneath the counter. Provide above counter outlets at the work area. Provide telecommunication outlets within easy reach of the work area.
- **Sink**
Provide a sink and faucet (gooseneck or kitchen type) combination deep enough to wash bottles and pump parts. Locate the sink adjacent to the work area. Indicate location for College provided soap dispenser.
- **Lighting and HVAC**
Task lighting should be provided over the sink and the work area. Provide overhead lighting for the room. Provide a thermostat in the room for user control and thermal comfort so that the room temperature can be maintained year-round at a comfortably warm level such as in a dressing room.
- **Milk Storage**
Provide a midsize or compact refrigerator for milk storage.

- **Accessories**

Provide a trashcan, a paper towel dispenser, a coat rack or coat hooks, a full-length mirror, a magazine rack, and a bulletin board. As many mothers may be sharing the room, provide a bulletin board or other scheduling device outside the door to help schedule room use.

For additional information about and sample diagrams of lactation room design, see the AIA Best Practices - Lactation/Wellness Room Design monograph at the following link:

https://wellnessroomsite.files.wordpress.com/2016/08/0908_lactation-room_english.pdf

End of Tab B-10

BAS Object Naming Standard

Equipment Schematics

PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
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-	-	-
-	-	-
-	-	-

STATUS: Version 1.0
DRAWN BY:
REV. DATE: **1/20/16**

SHEET TITLE & NUMBER:
1 of **27**



Introduction

The BAS Object Naming Standard is intended to standardize the names of BAS, Lighting, Metering, and other control objects. This standard is limited to thirty characters.

The provided diagrams are intended to aid the technician in finding the appropriate names for each object. The diagrams show generic HVAC, lighting, metering, and other equipment containing control points and objects, some of which may or may not be present in a particular application.

Any control object or point that is not represented in this standards document must be submitted to the client via RF1. A response shall be generated identifying the name that should be used for the application. If the supplied name is not currently represented in the standard document, it shall be added.

Object Engineering Units Descriptions

Object engineering units are suggested in parentheses, such as: (°F)

For analog points, the engineering units are provided. Engineering units are standardized, and the client should be consulted where the standard units are inappropriate for the measurement or application.

Generally, analog outputs are expressed in percent (% , or pct).

Binary outputs are generally expressed with (Off/On). Other binary units are provided depending on the application. The order of the state text labels is determined by the default position of the device. For example, a two-position damper that is normally closed would use the units (Closed/Open), whereas a damper that is normally open would use (Open/Closed).

Standard Engineering Units (Abbreviations)

Temperature = Degrees Fahrenheit (°F, degF, F)
Temperature = Degrees Celsius (°C, degC, C)
Water Pressure = Pounds per Square Inch (psi)
Air Pressure = Inches of Water Column ("wc, in-wc, inWC)
Relative Humidity = Percent (% , pct)
Enthalpy = BTUs per pound (btu-lb)
Water Flow = Gallons Per Minute (gpm)
Water Volume = Gallons (gal)
Natural Gas Volume = Cubit Feet, Hundred Cubit Feet, Therms (cf, ccf, therms)
Air Volume Flow = Cubic Feet per Minute (cfm)
Air Velocity = Feet Per Second (fps)
Steam Quantity = Pounds of Dry Steam (lbs)
Steam Flow Rate = Pounds per Hour (lbs-hr)
Rotating Speed = Rotations Per Minute (rpm)
Modulating Command = Percent (% , pct)
Valve Command = Percent Open (% , pct)
Diverting Valve Command = Percent Diverted (% , pct)
Carbon Dioxide (CO2) = Parts Per Million (ppm)
Carbon Monoxide (CO) = Parts Per Million (ppm)
Volatile Organic Compounds (VOC) = Parts Per Million (ppm)
Irradiance = Watts per Square Meter (Wm², Wm2)
Binary (Normally Off) = Off/On (Off/On)
Binary (Normally On) = On/Off (On/Off)
Binary (Normally Closed) = Closed/Open (Closed/Open)
Binary (Normally Open) = Open/Closed (Open/Closed)
Binary Alarm = Normal/Alarm (Normal/Alarm)
Electrical Power = Watts, Kilowatts, Megawatts (W, kW, MW)
Electrical Energy = Watt hours, Kilowatt Hours, Megawatt Hours (Wh, kWh, MWh)
Thermal Energy = British Thermal Units (btu, kbtu, mbtu)
Thermal Energy Rate = British Thermal Units per Hour (btu/hr, kbtu/hr, mbtu/hr)
Time = Seconds, Minutes, Hours (sec, min, hr, Hours)

Standard Object Name Format: BBBB_BBBBBB_NNNNNNNNNNNNNNN

Where:
BBBBB = Six-character Building Number or Abbreviation
BBBBB = Six-character Equipment/Location Designation (variable)
NNNNNNNNNNNNNNNN = Sixteen-character Standard Object Name

See ABRV page for Standard Object Name abbreviations.

Engineering Units, Scale, Precision, and COV Limits

Select an engineering unit appropriate for the scale of the data.

For example, when measuring electrical demand in a large commercial building, using Watts as the unit of measurement will produce a large figure that is difficult for a user to understand. A better choice would be kilowatts, which will report a manageable figure.

For a large industrial facility or power plant, kilowatts will not be appropriate, and megawatts or even gigawatts should be used.

The appropriate precision depends on the application, but in general temperatures and water pressures should be carried to 1/10th and air pressure should be carried to 1/100th. For most other measurements, 1/10th or 1/100th should be sufficient.

For many measurements, the ones digit is sufficient precision. Sensors measuring indoor air quality (CO2, CO, VOC), air volume or flow rate, water volume or flow rate, and many others really only require precision to the ones digit, or even to the tens digit for large values where information about minute changes carries little value for control or monitoring.

COV limit settings should be related to precision, depending upon which processes the COV limit will apply to (which may vary from one BAS product to the next). Generally-speaking, if a level of precision is required for proper control of a process, then it is reasonable to assume that an operator would wish to be updated with information at least as precise.

Standard Metering Object Name Format: BBBB_BTTMtr.DDDD_NNNNNNNNNNNNN

Where:
BBBBB = Six-character Building Number or Abbreviation
TT = Two-character Standard Meter Type Abbreviations
. = Standard Meter Delimiter
DDDDDDDD = Eight-character Meter Designation (variable)
NNNNNNNNNNNNNN = Twelve-character Standard Object Name

Standard Meter Type Abbreviations

CH = Chilled Water
CW = Condenser Water
DF = Diesel Fuel
DH = Domestic Hot Water
DW = Domestic Water
EL = Electricity
FO = Fuel Oil
GW = Gray (Reclaimed) Water
HW = Heating Hot Water
IW = Irrigation Water
MW = Make-up Water
NG = Natural Gas
PG = Propane Gas
PV = Photovoltaic Electricity
SH = Solar (Heat) Thermal Energy
ST = Steam
TW = Tempered Water
TE = Thermal Energy
WD = Wind Electricity

Example Meter Designations

Main = Main meter for facility
Sub = Submeter
BTU = Thermal Energy Meter
Rec = Received
Del = Delivered
Rcv = Recovered
HiPr = High-Pressure
MdPr = Medium-Pressure
LwPr = Low-Pressure
MSAAB1 = Electric Circuit
HPLLL1A = Electric Circuit
ELHPLL = Electric Circuit

PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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STATUS: Version 1.0

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REV. DATE: **1/20/16**

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INTRO

Standard Object Name Abbreviations

A
 Alm = Alarm (Off/On)
 Aux = Auxilliary
 AFMS = Air Flow Measuring Station
 Avg = Average
 Adj = Adjustment
 A = Phase A
 AppPwr = Apparent Power (KVA)
 Ats = Automatic Transfer Switch
B
 Batt = Battery
 B = Phase B
 Btn = Button
 Buzz = Buzzer
 Blr = Boiler
 Bstr = Booster
 Btu = British Thermal Units
 Base = Baseline
 Bb = Baseboard
 Bldg = Building
 Byp = Bypass
C
 Cl = Cooling
 Cmd = Command (Off/On)
 CC = Cooling Coil
 Cd = Conditioning, Condenser
 Cmp = Compressor
 CO2 = Carbon Dioxide
 CD = Cold Deck
 Clg = Cooling
 Coeff = Coefficient
 CdPan = Condenser Pan
 Chlr = Chiller
 Ctrl = Control
 Cur = Current
 Cap = Capacity
 CHW = Chilled Water
 CHWR = Chilled Water Return
 CHWS = Chilled Water Supply
 Cir = Circulation
 CT = Cooling Tower
 CW = Condenser Water
 CWR = Condenser Water Return
 CWS = Condenser Water Supply
 C = Phase C
 Cd = Condensate
 Chg = Change
 Cfctr = C-factor
 Comb = Combiner
 CtRatio = Current Transformer Ratio
D
 DirNorm = Direct Normal
 DA = Unit Discharge Air
 Dew = Dewpoint (°F)
 Dmd = Demand
 Dmp = Damper
 Db = Deadband
 Dif = Differential
 DCV = Demand-Controlled Ventilation
 Det = Detector
 Dly = Delay
 Dis = Discharge
 DHW = Domestic How Water
 Div = Diverting
 DW = Domestic Water

Standard Object Name Abbreviations

E
 EA = Exhaust Air
 Econ = Economizer
 Ena = Enable
 EF = Exhaust Fan
 Eff = Effective
 Enrg = Energy (kWh)
 Enth = Enthalpy
 Ent = Entering
 Ev = Evaporator
 Eject = Ejection
 EVID = Electric Vehicle Identification
F
 Flt = Fault
 Freq = Frequency
 Flw = Flow
 FByP = Face/Bypass
 Frst = Frost
 Fast = Fast Fan Speed
 Fdbk = Speed Control Feedback (%)
 Flt = Filter
G
 GH = Gas Heater
 Glb = Global
 Gly = Ethylene Glycol
 Gen = Generator
H
 HPrs = High-Pressure
 Hor = Horizontal
 Hr = Hour
 HW = Hot Water
 HWR = Hot Water Return
 HWS = Hot Water Supply
 HX = Heat Exchanger
 HD = Hot Deck
 Hi = High
 High = High Fan Speed
 Htg = Heating
 HC = Heating Coil
 HL = High Limit
 Hum = Humidifier
 Ht = Heating
I
 IAQ = Indoor Air Quality, Air Quality
 Inlet = Fan Air Inlet
 Irrad = Irradiance
 Iso = Isolation
 Ind = Indicator
 Inf = Infectious
 In = Input
 Inv = Inverter
K
 Kfctr = K-factor
 kW = Kilowatts
 kWh = Kilowatt Hours
L
 Lck = Lockout
 Lnk = Link
 Lvr = Louver
 LL = Line-to-Line
 LL = Low Limit
 LN = Line-to-Neutral
 LPrs = Low-Pressure
 Lmt = Limit
 Lvg = Leaving
 Lo = Low
 Low = Low Fan Speed

Standard Object Name Abbreviations

M
 MA = Mixed Air
 Man = Manual
 Mod = Mode, Modulation, Modulating
 Max = Maximum
 Min = Minimum
 Med = Medium Fan Speed
 Mf = Manifold
 MPrs = Medium-Pressure
 MU = Make-Up
N
 Neg = Negative
 Neut = Neutral
O
 OA = Outside Air
 Occ = Occupied
 Ovrd = Override
 Out = Output
 Oper = Operation, Operator
 OAF = Outside Air Fan
 OT = OverTime
P
 PC = Pre-Cool
 PH = Pre-Heat
 Par = Parallel
 Pmp = Pump
 Pri = Primary
 Perf = Performance
 PhsRev = Phase Reversal
 POA = Plane of Array
 Precip = Precipitation
 Prev = Previous
 Pro = Protective
 PtRatio = Potential Transformer Ratio
 PwrFct = Power Factor
 Pls = Pulse, Pulses
 Pct = Percentage, Percent
 Pos = Position (%), Positive
 Prs = Pressure (PSI, inWC)
 Pwr = Power (kW)
R
 RA = Return Air
 RelHum = Relative Humidity (%)
 RnTm = Run Time (hours)
 Rst = Reset
 Rev = Reversing
 RF = Return Fan
 RH = Re-Heat
 Rng = Range
 RstH = High End of Reset Scale
 RstL = Low End of Reset Scale
 Rcv = Recovery, Recovered
 Rec = Recovery
 Rfg = Refrigerant
 Rej = Rejection, Rejected
 Req = Required
 Rev = Reversing
 Rat = Rate
 Rm = Room
 RctPwr = Reactive Power (kVAR)
 Rly = Relay
 RelPwr = Real Power (kW)
 Rem = Remaining
 RO = Relay Output

Standard Object Name Abbreviations

S
 Serial = Serial Number
 SA = Supply Air
 Smk = Smoke
 Sp = Setpoint
 Spd = Speed Control Command (%)
 Sts = Status (Off/On)
 SF = Supply Fan
 Stg = Stage
 Sw = Switch
 Snsr = Sensor
 Slow = Slow Fan Speed
 Stby = Standby
 Stm = Steam
 Sec = Secondary
 Seq = Sequence
 Ser = Series, Service
 Strts = Starts
 SqFt = Square Feet
 Str = Strainer
 Snw = Snow, Snow-melt
 Sup = Supply
T
 Trk = Tracking
 THD = Total Harmonic Distortion
 Tons = Tons of Refrigeration
 Tot = Total
 Tm = Time
 Tmp = Temperature (°F)
U
 Uoc = Unoccupied
 Unbal = Unbalanced
 UTC = Universal Time Clock
 Unoc = Unoccupied
 User = Space Occupant
V
 Vib = Vibration
 VAC = Volts Alternating Current
 VDC = Volts Direct Current
 Vlt = Voltage
 Vel = Velocity
 Vent = Ventilation
 Vlv = Valve
 VOC = Volatile Organic Compounds
 Vol = Volume
W
 Warn = Warning
 Wh = Wheel
 Wtr = Water
Z
 Zn = Zone

PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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STATUS: Version 1.0

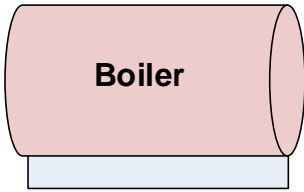
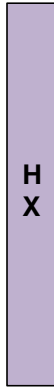
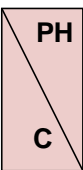
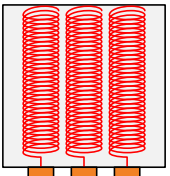



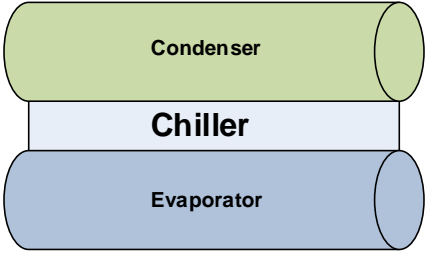
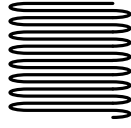
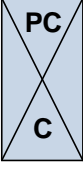
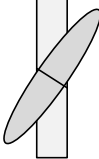


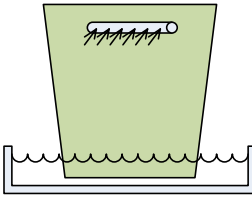

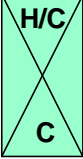
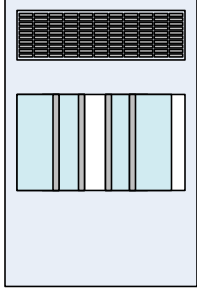



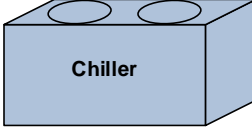
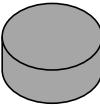
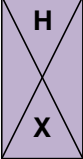

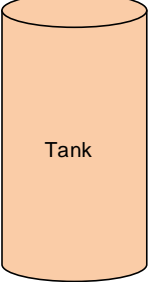

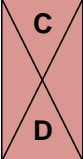



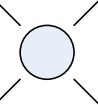
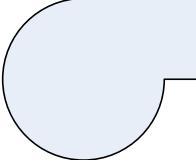


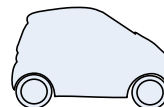
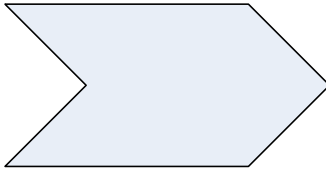

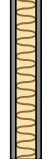
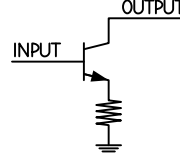




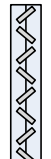
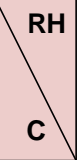

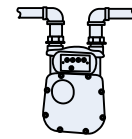




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ABRV

	Boiler		Air-to-Air Heat Exchanger		Pre-Heating Coil		Electric Duct Heater		Thermal Energy Meter		Averaging Duct Temperature Sensor		Weather Station		
	Water-Cooled Chiller			Coil		Pre-Cooling Coil		Terminal Unit Damper			Wireless				Averaging Duct Temperature Switch
	Cooling Tower			Variable Frequency Drive		2-Pipe Heating/Cooling Coil		Lab Fume Hood		Fuse		Duct Smoke Detector		Space Relative Humidity Sensor	
			Air-Cooled Chiller			DX Compressor								Heat Exchanger Coil	
	Storage Tank		Cooling Coil		Condenser Coil		Water-to-Water Heat Exchanger		Damper Actuator		Hydronic Pressure Sensor		Lighting Load		
			Fan or Pump						Heating Coil					Air Flow Measuring Station	
	Ductwork		DX Coil		Filter		Open Collector Output		Strainer		Air Temperature Duct Sensor		Air Pressure Differential Sensor		
									Gas Duct Heater						Control Damper
			Reheat Coil		Face/Bypass Damper		Gas Meter		IAQ		Pyranometer		OSA Relative Humidity Sensor		OSA Air Quality Sensor

PROJECT

BAS Object Naming Standard
Equipment Schematics

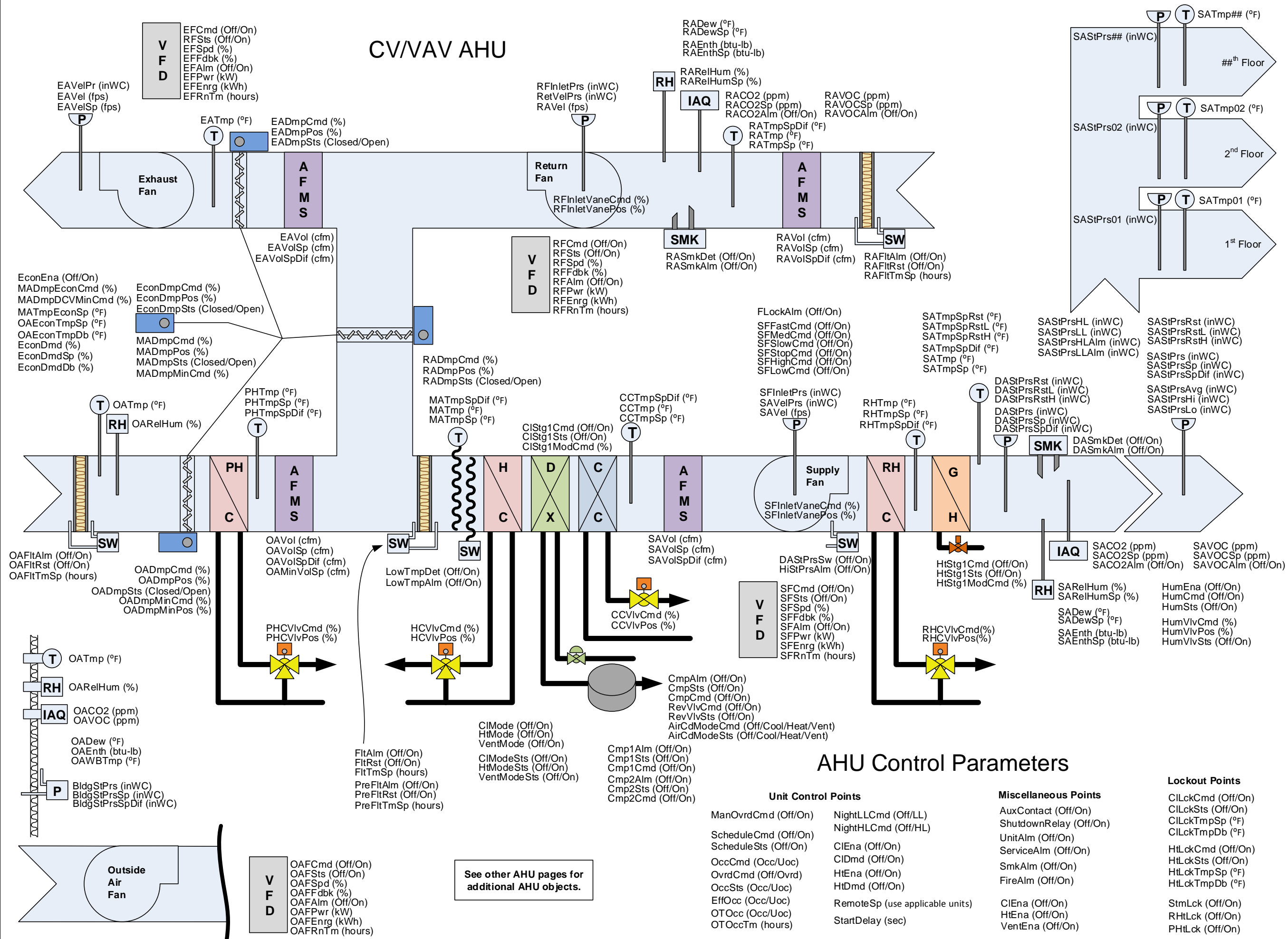
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STATUS: Version 1.0
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LEGEND

CV/VAV AHU



- VFD**
- EFCmd (Off/On)
 - RFSSts (Off/On)
 - EFSpd (%)
 - EFFdbk (%)
 - EFAIm (Off/On)
 - EFPwr (kW)
 - EFEnrg (kWh)
 - EFRnTm (hours)

- VFD**
- EconEna (Off/On)
 - MADmpEconCmd (%)
 - MADmpDCVMinCmd (%)
 - MATmpEconSp (°F)
 - OAEconTmSp (°F)
 - OAEconTmDb (°F)
 - EconDmd (%)
 - EconDmdSp (%)
 - EconDmdDb (%)

- VFD**
- OAFitAlm (Off/On)
 - OAFitRst (Off/On)
 - OAFitTmSp (hours)
 - OADmpCmd (%)
 - OADmpPos (%)
 - OADmpSts (Closed/Open)
 - OADmpMinCmd (%)
 - OADmpMinPos (%)

- VFD**
- OADew (°F)
 - OAEnth (btu-lb)
 - OAwbTm (°F)
 - BldgStPrs (inWC)
 - BldgStPrsSp (inWC)
 - BldgStPrsSpDif (inWC)

- VFD**
- OAFcmd (Off/On)
 - OAFSts (Off/On)
 - OAFSpd (%)
 - OAFdbk (%)
 - OFAIm (Off/On)
 - OAFPwr (kW)
 - OAFEnrg (kWh)
 - OAFRnTm (hours)

- VFD**
- RFCmd (Off/On)
 - RFSSts (Off/On)
 - RFSpd (%)
 - RFFdbk (%)
 - RFAIm (Off/On)
 - RFPwr (kW)
 - RFErg (kWh)
 - RFRnTm (hours)

- VFD**
- SFCmd (Off/On)
 - SFSts (Off/On)
 - SFSpd (%)
 - SFFdbk (%)
 - SFAIm (Off/On)
 - SFPwr (kW)
 - SFEnrg (kWh)
 - SFRnTm (hours)

See other AHU pages for additional AHU objects.

AHU Control Parameters

- | | | |
|--|--|--|
| <p>Unit Control Points</p> <ul style="list-style-type: none"> ManOvrCmd (Off/On) ScheduleCmd (Off/On) ScheduleSts (Off/On) OccCmd (Occ/Uoc) OvrCmd (Off/Ovr) OccSts (Occ/Uoc) EffOcc (Occ/Uoc) OTOcc (Occ/Uoc) OTOccTm (hours) | <p>Miscellaneous Points</p> <ul style="list-style-type: none"> AuxContact (Off/On) ShutdownRelay (Off/On) UnitAlm (Off/On) ServiceAlm (Off/On) SmkAlm (Off/On) FireAlm (Off/On) CIEna (Off/On) HIEna (Off/On) VentEna (Off/On) | <p>Lockout Points</p> <ul style="list-style-type: none"> CIlckCmd (Off/On) CIlckSts (Off/On) CIlckTmSp (°F) CIlckTmDb (°F) HIlckCmd (Off/On) HIlckSts (Off/On) HIlckTmSp (°F) HIlckTmDb (°F) StmLck (Off/On) RHLck (Off/On) PHLck (Off/On) |
|--|--|--|

PROJECT

BAS Object Naming Standard

Equipment Schematics

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STATUS: Version 1.0

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AHUVAV

Zone Control

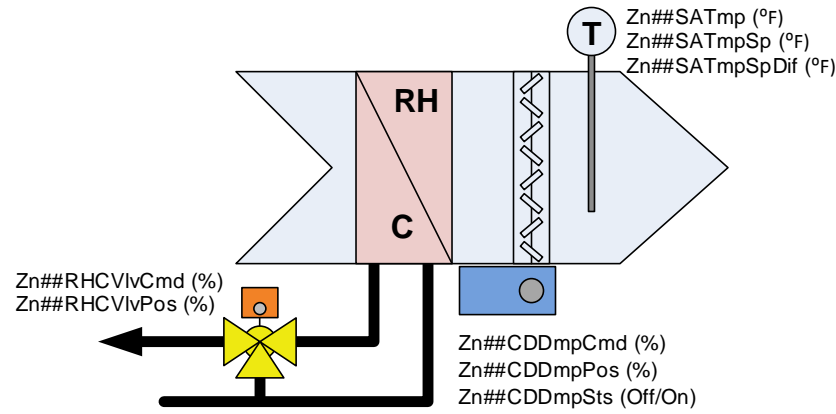
- Zn##OccCmd (Off/On)
 - Zn##EffTmp (°F)
 - Zn##EffSp (°F)
 - Zn##OccClgSp (°F)
 - Zn##OccHtgSp (°F)
 - Zn##UnocClgSp (°F)
 - Zn##UnocHtgSp (°F)
 - Zn##StbyClgSp (°F)
 - Zn##StbyHtgSp (°F)
- T** Zn##Tmp (°F)
Zn##TmpSp (°F)
 - RH** Zn##RelHum (%)
Zn##RelHumSp (%)
Zn##Enth (btu-lb)
Zn##EnthSp (btu-lb)
Zn##Dew (°F)
Zn##DewSp (°F)
 - IAQ** Zn##CO2 (ppm)
Zn##CO2Sp (ppm)
Zn##CO2Alm (Off/On)
Zn##IAQAlm (Off/On)
Zn##VOC (ppm)
Zn##VOCSp (ppm)
Zn##VOCAIm (Off/On)

See other AHU pages for additional AHU objects.

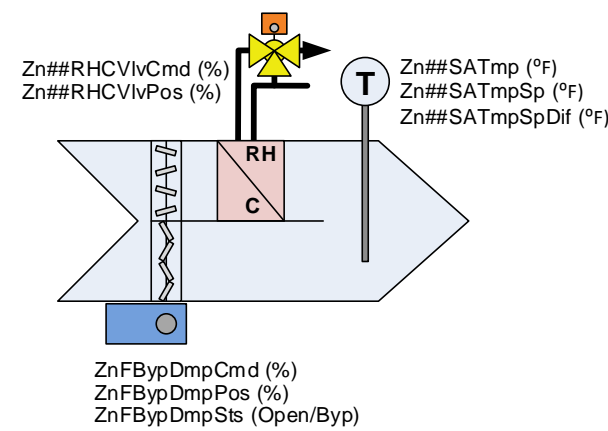
General Zone Management

- ZnDmpMax (%)
- ZnDmpMin (%)
- ZnDmpAvg (%)
- ZnHDDmpMax (%)
- ZnHDDmpMin (%)
- ZnHDDmpAvg (%)
- ZnCDDmpMax (%)
- ZnCDDmpMin (%)
- ZnCDDmpAvg (%)
- ZnRHCVlvMax (%)
- ZnRHCVlvMin (%)
- ZnRHCVlvAvg (%)

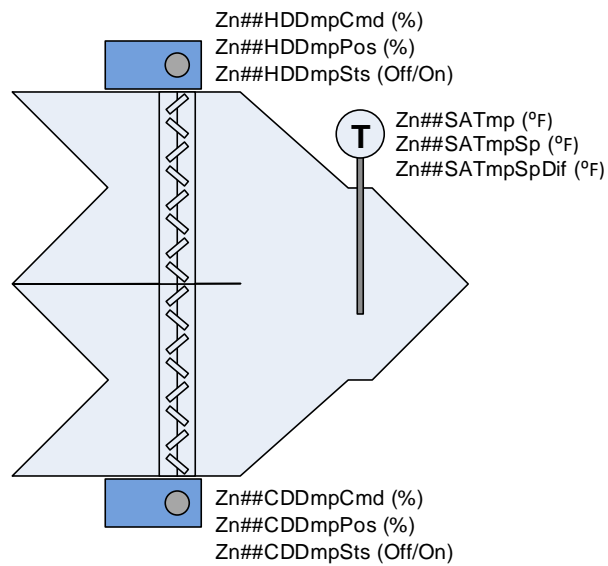
Single-duct Zone Damper



Face/Bypass Zone Damper



Dual-duct Zone Dampers



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

STATUS: Version 1.0

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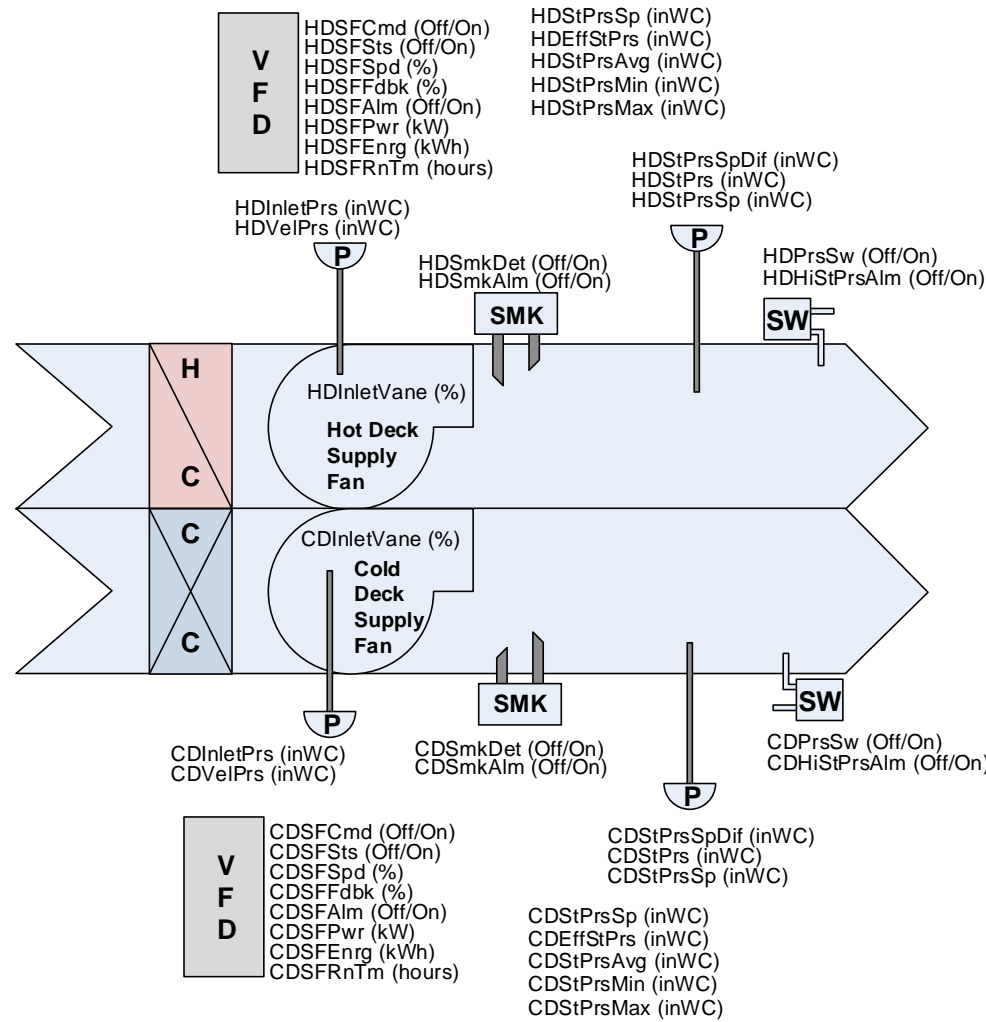
REV. DATE: 1/20/16

SHEET TITLE & NUMBER:

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AHUMZ

Dual Supply Fan Dual Duct AHU



AHU Control Parameters

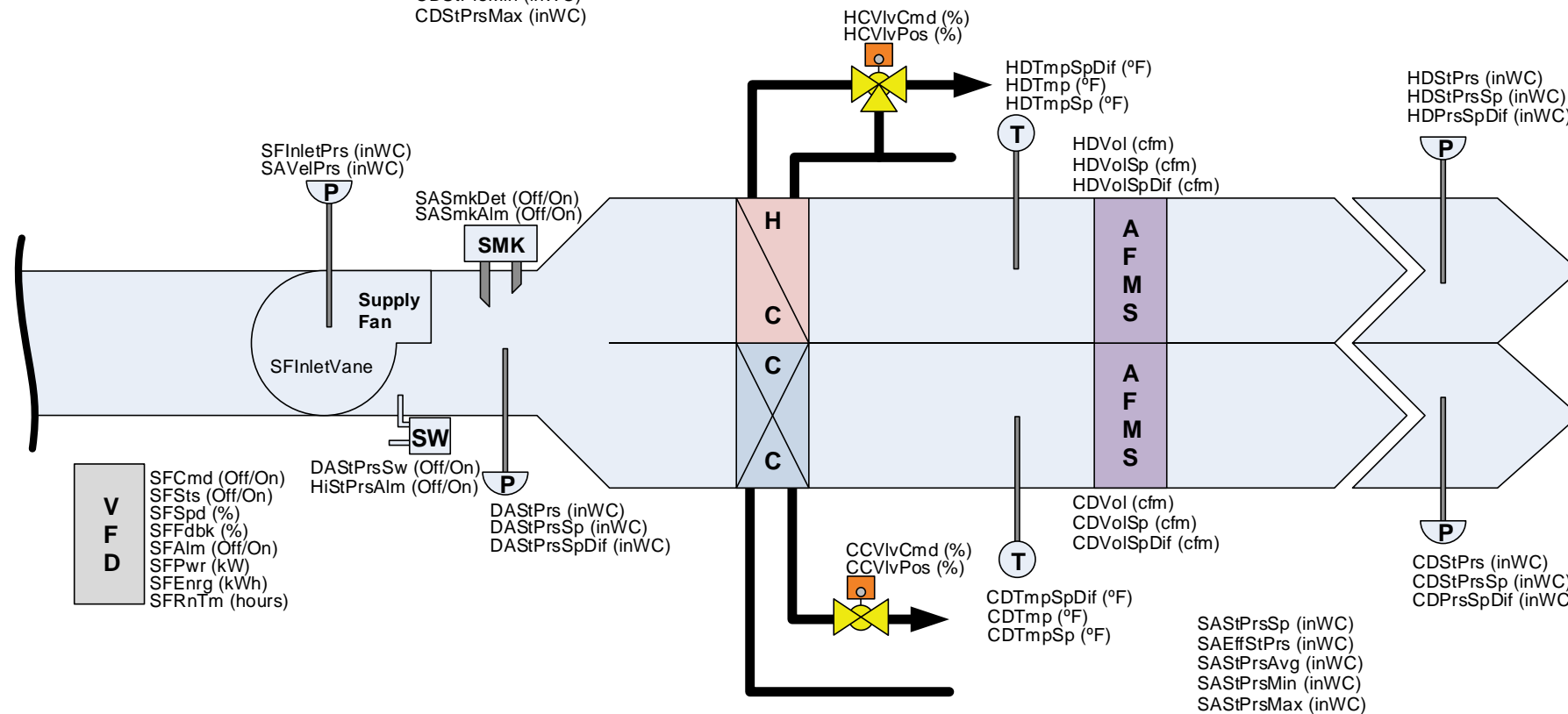
- | Unit Control Points | Miscellaneous Points | Lockout Points |
|--|---|---|
| ManOvrCmd (Off/On)
ScheduleCmd (Off/On)
ScheduleSts (Off/On)
OccCmd (Occ/Uoc)
OvrCmd (Off/Ovr)
OccSts (Occ/Uoc)
EffOcc (Occ/Uoc)
OTOcc (Occ/Uoc)
OTOccTm (hours) | NightLLCmd (Off/LL)
NightHLCmd (Off/HL)
CIEna (Off/On)
CIDmd (Off/On)
HtEna (Off/On)
HtDmd (Off/On)
RemoteSp (use applicable units)
StartDelay (sec) | AuxContact (Off/On)
ShutdownRelay (Off/On)
UnitAlm (Off/On)
ServiceAlm (Off/On)
SmkAlm (Off/On)
FireAlm (Off/On) |
| | | CILckCmd (Off/On)
CILckSts (Off/On)
CILckTmpSp (°F)
CILckTmpDb (°F)
HtLckCmd (Off/On)
HtLckSts (Off/On)
HtLckTmpSp (°F)
HtLckTmpDb (°F)
StmLck (Off/On)
RHtLck (Off/On)
PHtLck (Off/On) |

See other AHU pages for additional AHU objects.

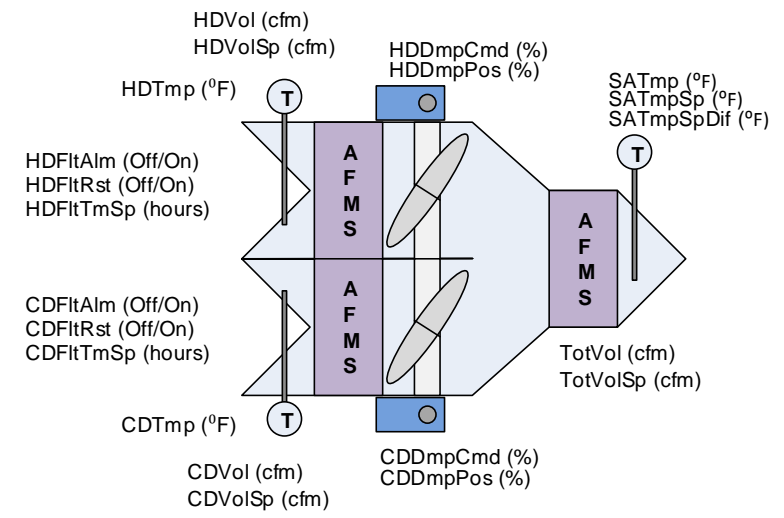
Zone Control Setpoints

- | | | |
|---|---|---|
| OccCmd (Occ/Uoc)
UnocOvrCmd (Uoc/Ovr)
OvrTimeSp (hours) | Tmp (°F)
TmpSp (°F) | MinCIVolSp (cfm)
MaxCIVolSp (cfm)
MinHtVolSp (cfm)
MaxHtVolSp (cfm)
MinTotVolSp (cfm)
MaxTotVolSp (cfm) |
| EffTmp (°F)
EffSp (°F)
OccClgSp (°F)
OccHtgSp (°F)
UnocClgSp (°F)
UnocHtgSp (°F)
StbyClgSp (°F)
StbyHtgSp (°F) | UserSpAdjEna (Off/On)
UserSpAdjRng (°F)
UserSpAdjHL (°F)
UserSpAdjLL (°F)
UserSpAdj (°F)
EffUserSp (°F)
OccSnsrSts (Off/On) | AirFlowPct (%)
AirFlowPctSp (%)
OccAirVolSp (cfm)
UnocAirVolSp (cfm)
HDDuctArea (sqft)
HDVolCoeff (coeff)
CDDuctArea (sqft)
CDVolCoeff (coeff) |

Single Supply Fan Dual Duct AHU



Dual-duct Terminal Unit



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

STATUS: Version 1.0

DRAWN BY:

REV. DATE: 1/20/16

SHEET TITLE & NUMBER: 7 of 27

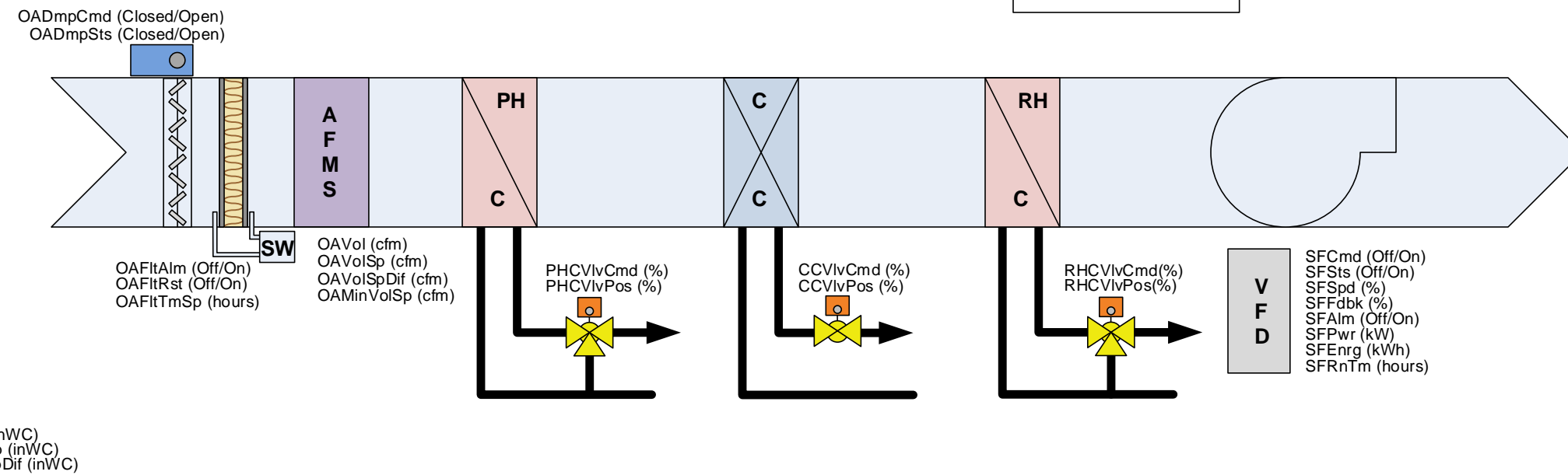
PROJECT

BAS Object Naming Standard

Equipment Schematics

OSA AHU/MUA AHU

See other AHU pages for additional AHU objects.



#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
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-	-	-
-	-	-

STATUS: Version 1.0

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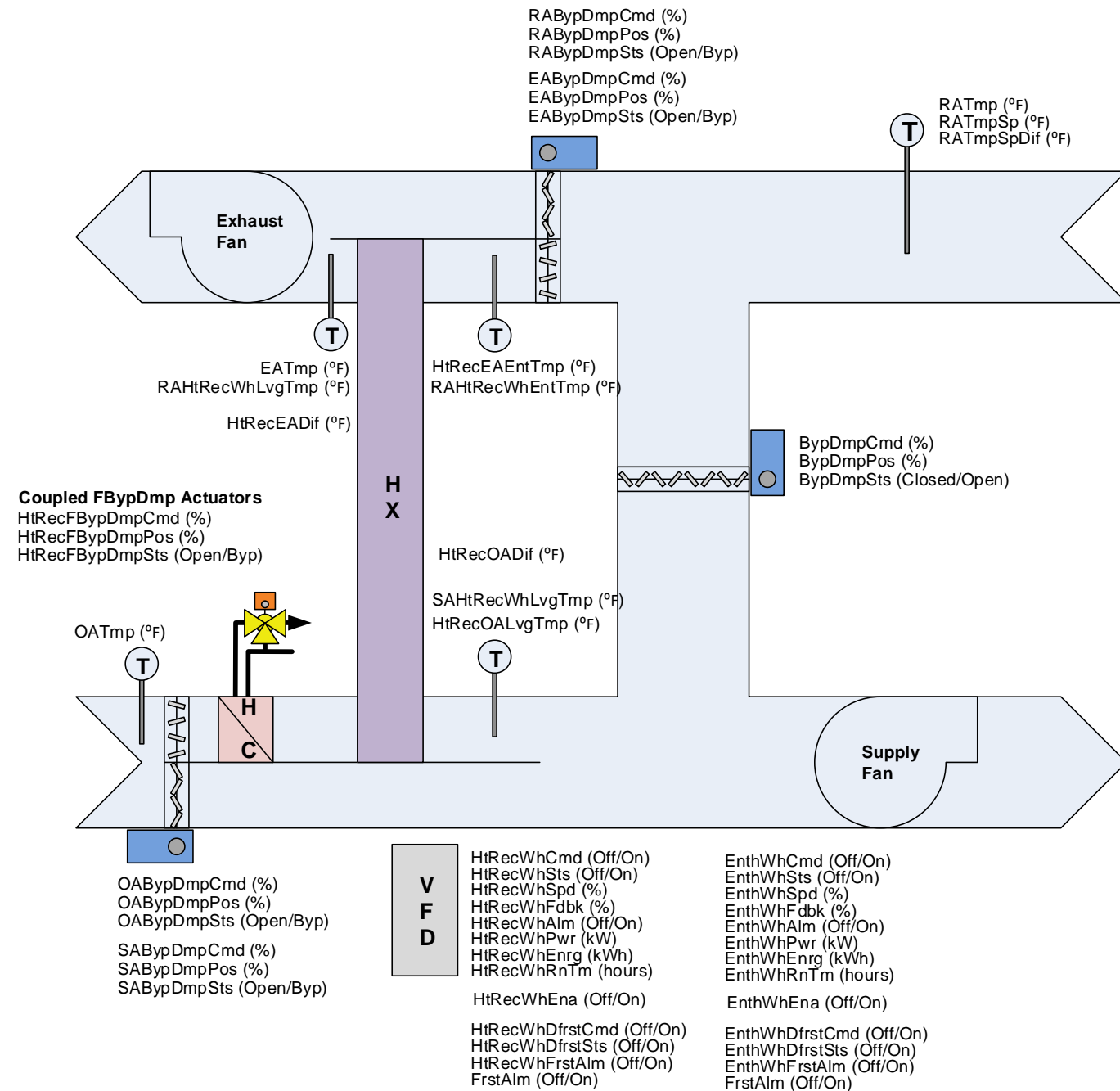
AHUOA

Heat Recovery Control Objects

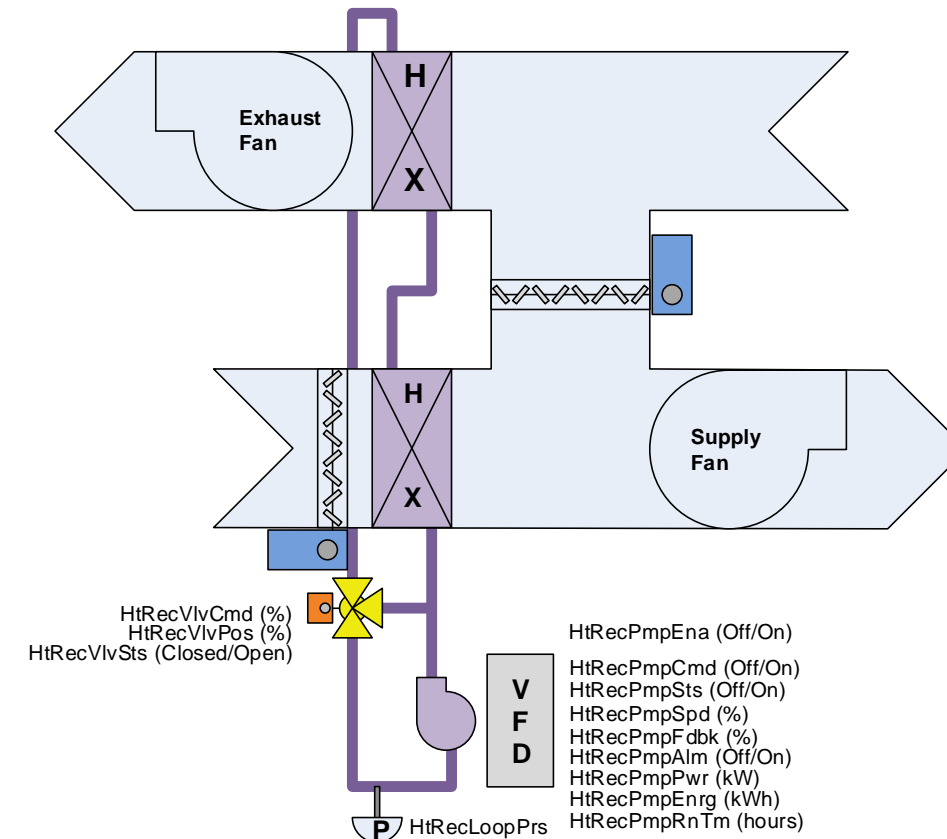
- HtRecEna (Off/On)
- HtRecMode (Recover/Reject)
- HtRcvMode (Off/On)
- HtRejMode (Off/On)
- HtRecDif (°F)
- HtRecDifSp (°F)
- HtRecovered (btu)
- HtRejected (btu)
- HtRecEff (%)
- HtRecEffBase (%)
- HtRcvModeSp (°F)
- HtRejModeSp (°F)
- HtRcvModeDb (°F)
- HtRejModeDb (°F)
- HtRecOATmpSp (°F)
- HtRecOATmpDb (°F)
- HtRecDifSp (°F)
- HtRecDifDb (°F)

See other AHU pages for additional AHU objects.

Air-to-Air Heat Recovery



Hydronic Heat Recovery



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

STATUS: Version 1.0

DRAWN BY: mg

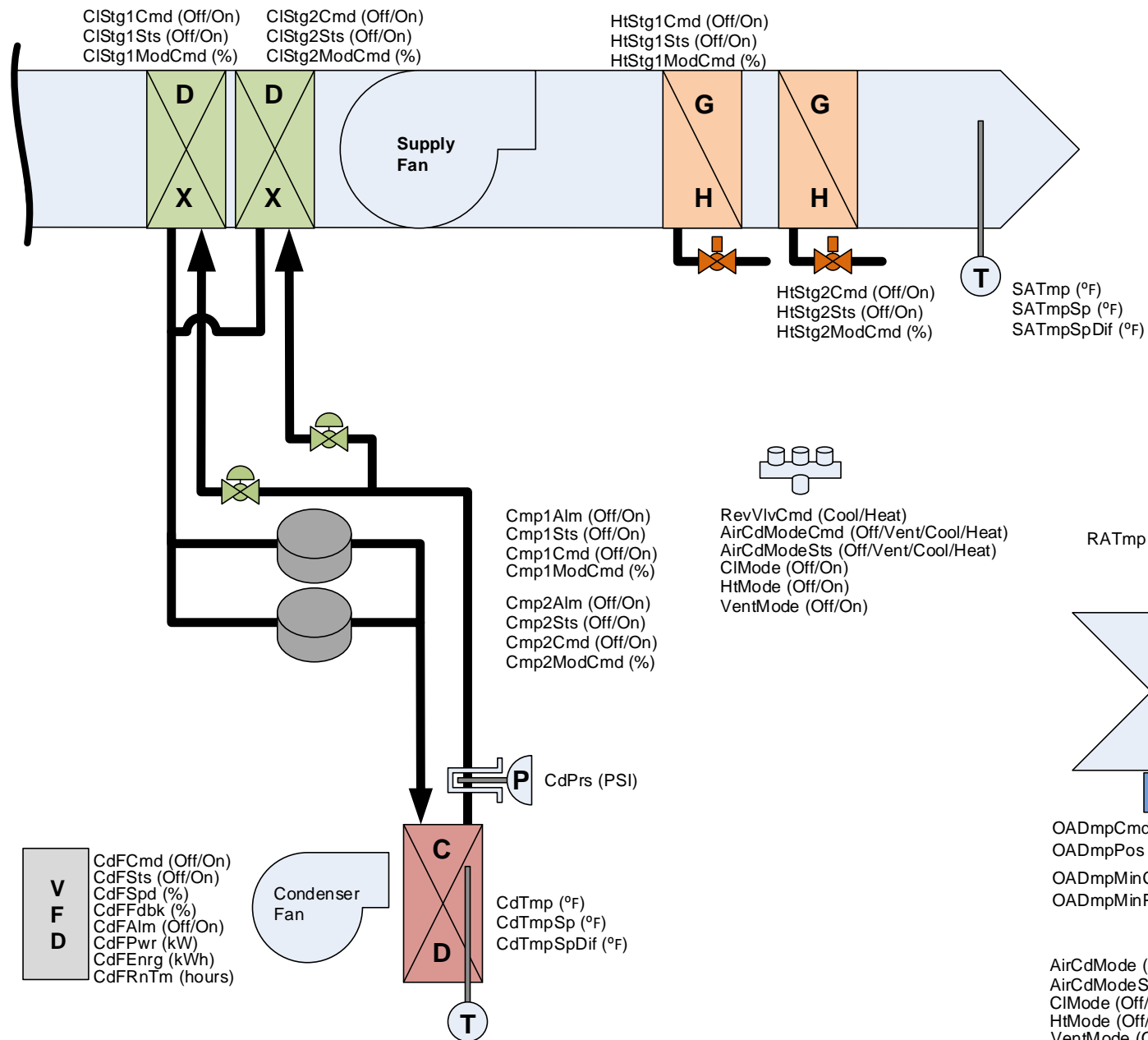
REV. DATE: 1/20/16

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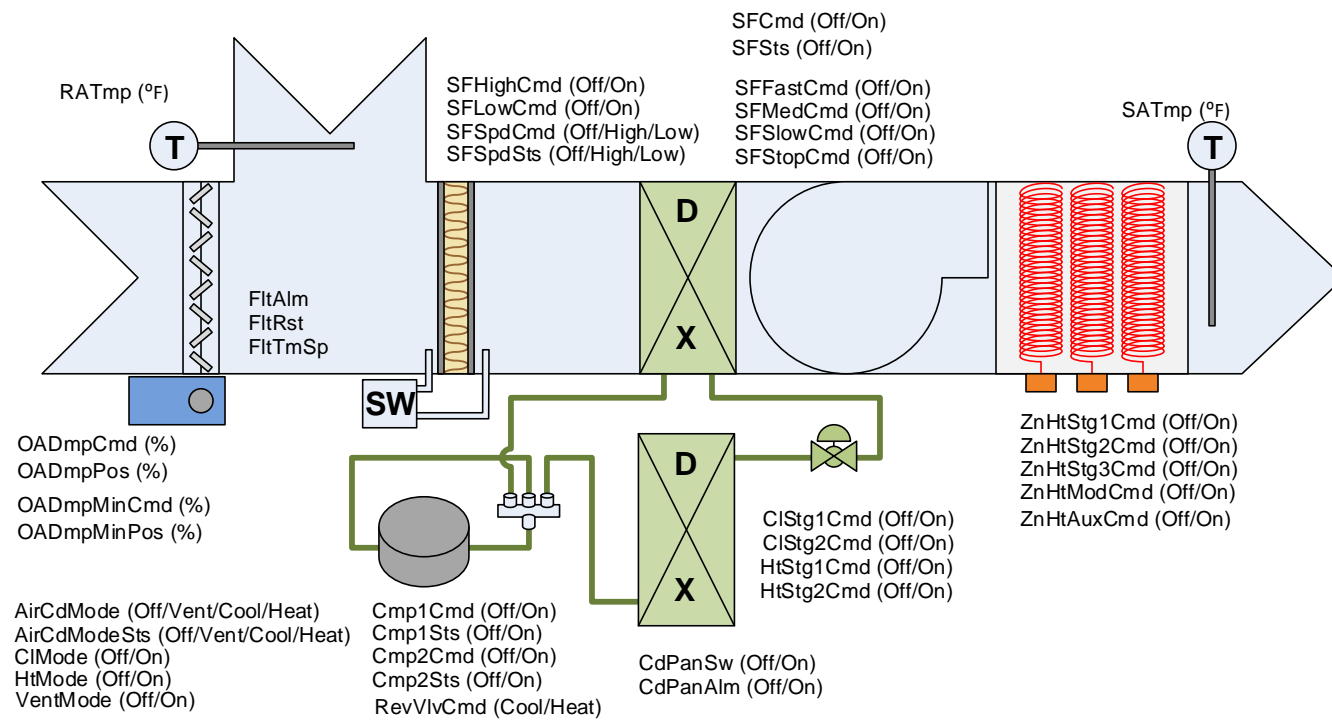
HXR

DX AHU w/ Gas Heat



See other AHU pages for additional AHU objects.

Unit Ventilator/Heat Pump



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

STATUS: Version 1.0

DRAWN BY:

REV. DATE: 1/20/16

SHEET TITLE & NUMBER:

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AHUDX

Zone Control Setpoints

OccCmd (Occ/Uoc)
UnocOvrCmd (Uoc/Ovr)
OvrTimeSp (hours)

OccRmTmpSp (°F)
UnocRmTmpSp (°F)

EffRmTmp (°F)
EffRmTmpSp (°F)
OccClgSp (°F)
OccHtgSp (°F)
UnocClgSp (°F)
UnocHtgSp (°F)
StbyClgSp (°F)
StbyHtgSp (°F)

UserSpAdjEne (Off/On)
UserSpAdjRng (°F)
UserSpAdjHL (°F)
UserSpAdjLL (°F)
UserSpAdj (°F)
EffUserSp (°F)
OccSnsrSts (Off/On)

T RmTmp (°F)
RmTmpSp (°F)

RH RmRelHum (%)
RmRelHumSp (%)
RmEnth (btu-lb)
RmEnthSp (btu-lb)
RmDew (°F)
RmDewSp (°F)

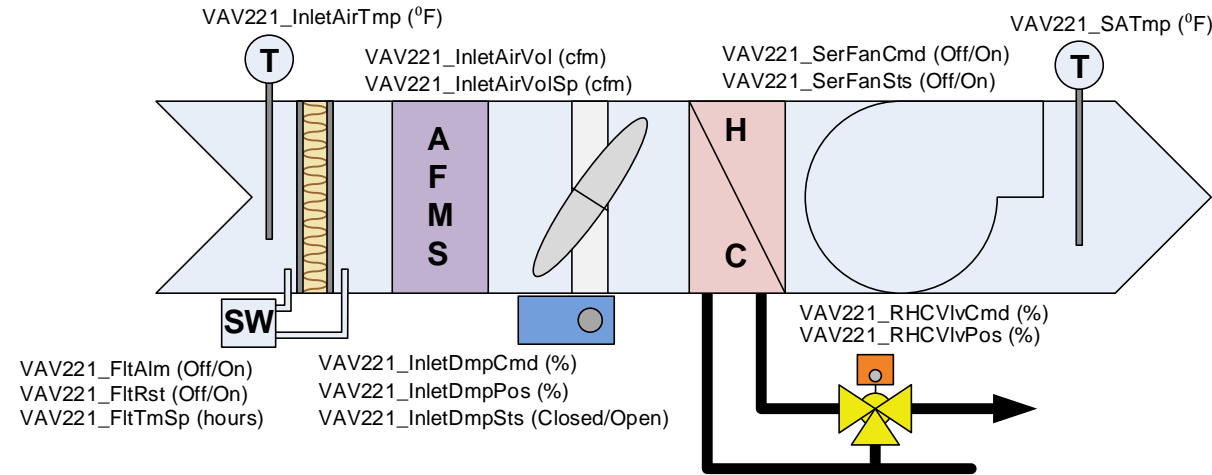
IAQ RmCO2 (ppm)
RmCO2Sp (ppm)
RmCO2Alm (Off/On)
RmIAQAlm (Off/On)
RmVOC (ppm)
RmVOCSp (ppm)
RmVOCAlm (Off/On)

AirCdModeCmd (Cool/Heat)
AirCdModeSts (Cool/Heat)
CIModeSts (Off/On)
HtModeSts (Off/On)
StbyModeSts (Off/On)

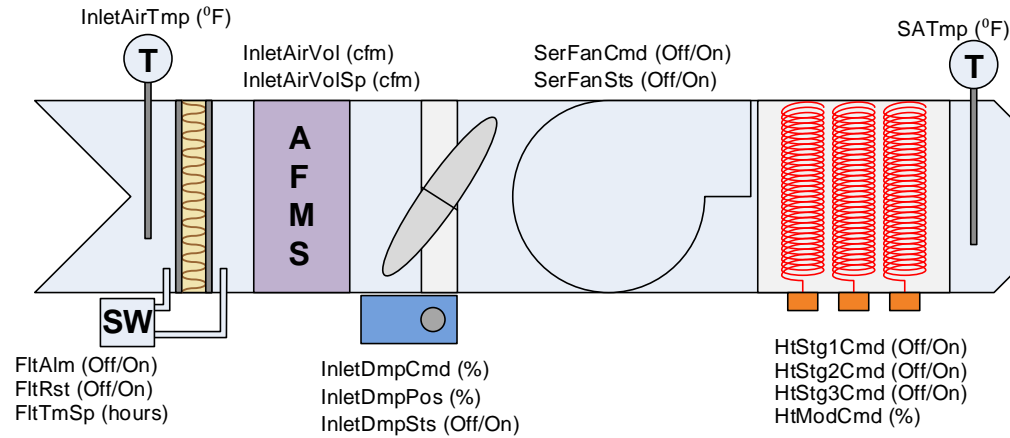
MinCIVolSp (cfm)
MaxCIVolSp (cfm)
MinHtVolSp (cfm)
MaxHtVolSp (cfm)
AirFlowPct (%)
AirFlowPctSp (%)
OccAirVolSp (cfm)
UnocAirVolSp (cfm)
DuctArea (sqft)
VolCoeff (coeff)

In this example, "VAV221_" is the equipment designator.

VAV w/ Series Fan & HW Reheat

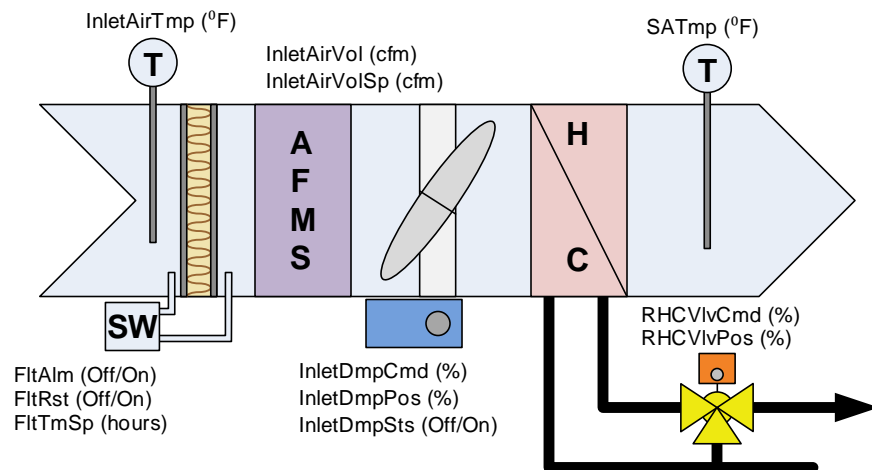


VAV w/ Series Fan & Electric Reheat

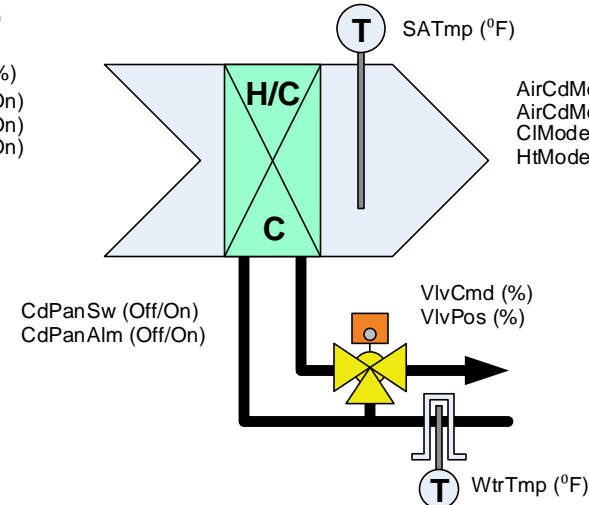


For baseboard Ht: BbHtStg1Cmd (Off/On)
BbHtStg2Cmd (Off/On)
BbHtStg3Cmd (Off/On)

CV/VAV/VVT w/ HW Reheat

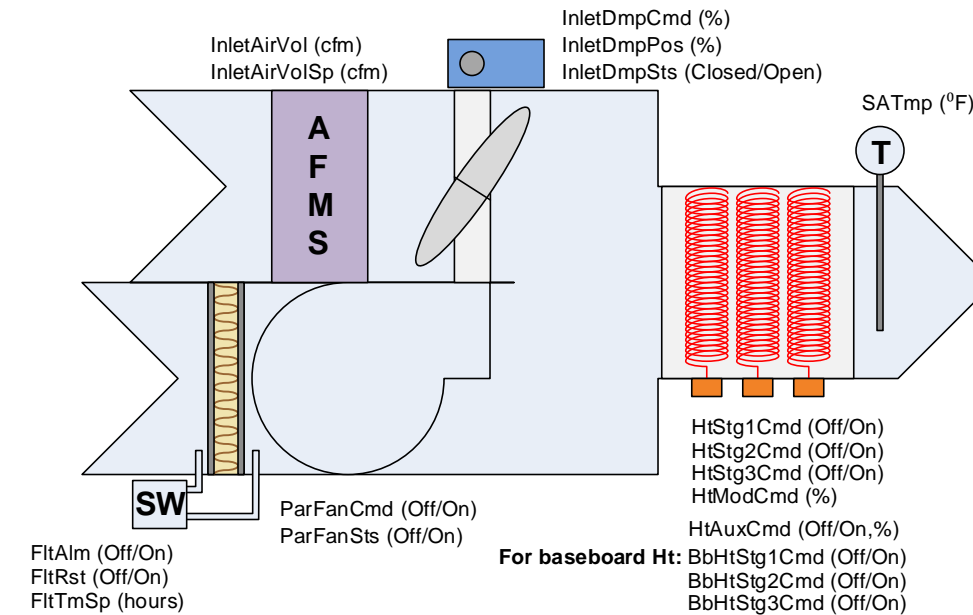


2-Pipe Coil



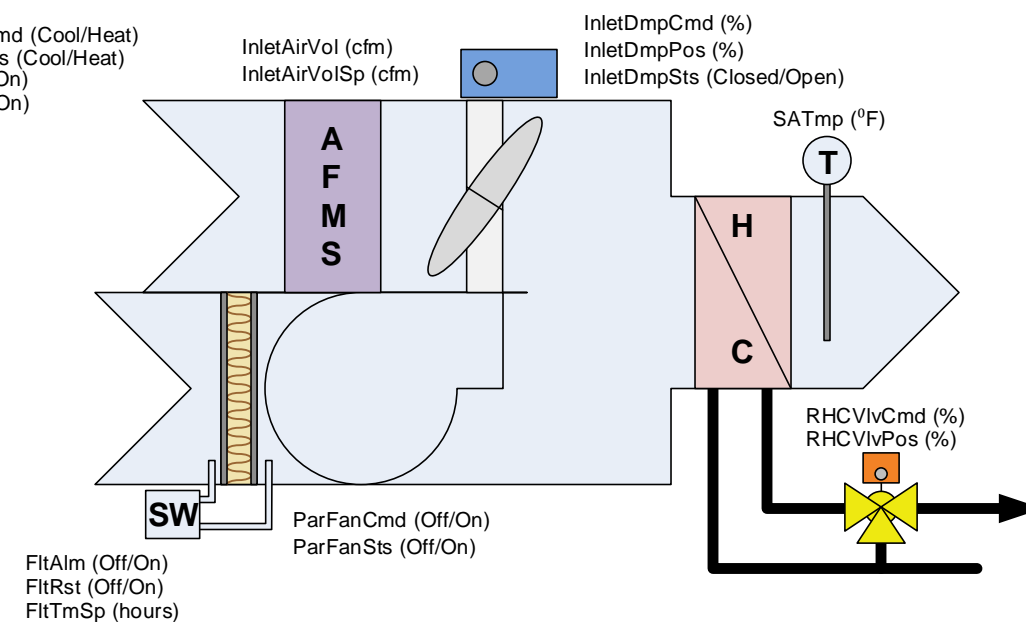
AirCdModeCmd (Cool/Heat)
AirCdModeSts (Cool/Heat)
CIMode (Off/On)
HtMode (Off/On)

VAV w/ Parallel Fan & Electric Reheat



For baseboard Ht: BbHtStg1Cmd (Off/On)
BbHtStg2Cmd (Off/On)
BbHtStg3Cmd (Off/On)

VAV w/ Parallel Fan & HW Reheat



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
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STATUS: Version 1.0

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VAV

Zone Control Setpoints

OccCmd (Occ/Uoc)
UnocOvrCmd (Uoc/Ovrd)
OvrTimeSp (hours)



RmTmp (°F)
RmTmpSp (°F)

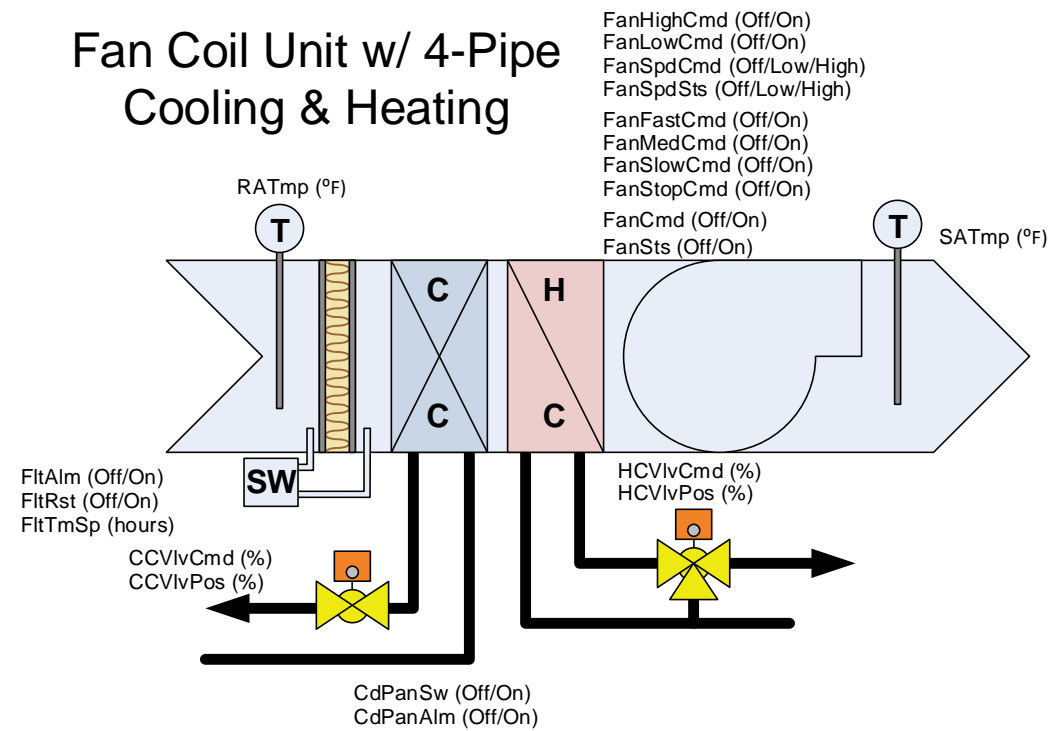
EffRmTmp (°F)
EffRmTmpSp (°F)
OccClgSp (°F)
OccHtgSp (°F)
UnocClgSp (°F)
UnocHtgSp (°F)
StbyClgSp (°F)
StbyHtgSp (°F)

AirCdModeCmd (Cool/Heat)
AirCdModeSts (Cool/Heat)
CIModeSts (Off/On)
HtModeSts (Off/On)
StbyModeSts (Off/On)

UserSpAdjEna (Off/On)
UserSpAdjRng (°F)
UserSpAdjHL (°F)
UserSpAdjLL (°F)
UserSpAdj (°F)
EffUserSp (°F)
OccSnsrSts (Off/On)

See other AHU and TermUnits pages for additional points.

Fan Coil Unit w/ 4-Pipe Cooling & Heating



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
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STATUS: Version 1.0

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FCU

General Objects

UnitStartCmd (Off/On)
 SysSts (varies)
 SysOpState (varies)
 AutoMode (Manual/Auto)
 Shtdn (Off/On)
 Stby (Off/On)
 SATmp (°F)
 RATmp (°F)
 OATmp (°F)
 ZnTmp (°F)
 SARElHum (%)
 RARElHum (%)
 OARElHum (%)
 ZnRelHum (%)
 SADew (°F)
 RADew (°F)
 OADew (°F)
 ZnDew (°F)
 CHWSTmp (°F)
 CHWRTmp (°F)
 CWSTmp (°F)
 CWRtmp (°F)
 CHWFlwSw (Off/On)
 CWFlwSw (Off/On)
 CHWFlwRat (gpm)
 CWFlwRat (gpm)
 FanSts (Off/On)
 CHWVlvPos (%)
 CWVlvPos (%)
 CmpSts (Off/On)
 PmpSts (Off/On)
 CIMode (Off/On)
 HtmMode (Off/On)
 DehumMode (Off/On)
 HumMode (Off/On)
 EconMode (Off/On)
 ActCapPct (%)
 ZnEnth (btu-lb)
 SAEnth (btu-lb)
 RAEnth (btu-lb)
 OAEth (btu-lb)

Description

Unit On/Off Command
 System Status
 System Operating State
 System Operating State
 Unit Shutdown
 Unit Standby
 Supply Air Temperature
 Return Air Temperature
 Outside Air Temperature
 Zone Air Temperature
 Supply Air Relative Humidity
 Return Air Relative Humidity
 Outside Air Relative Humidity
 Zone Relative Humidity
 Supply Air Dew Point Temperature
 Return Air Dew Point Temperature
 Outside Air Dew Point Temperature
 Zone Air Dew Point Temperature
 Chilled Water Supply Temperature
 Chilled Water Return Temperature
 Condenser Water Supply Temperature
 Condenser Water Return Temperature
 Chilled Water Flow Switch
 Condenser Water Flow Switch
 Chilled Water Flow Rate
 Condenser Water Flow Rate
 Fan Status
 Chilled Water Valve Position
 Condenser Water Valve Position
 Compressor Status
 Pump Status
 Cooling Mode
 Heating Mode
 Dehumidification Mode
 Humidification Mode
 Economizer Mode
 Active Capacity Percentage
 Zone Enthalpy
 Supply Air Enthalpy
 Return Air Enthalpy
 Outside Air Enthalpy

Set Points

ZnTmpSp (°F)
 ZnDewSp (°F)
 ZnRelHumSp (%)
 ZnEnthSp (btu-lb)

Description

Zone Temperature Set Point
 Zone Dew Point Temperature Set Point
 Zone Relative Humidity Set Point
 Zone Enthalpy Set Point

Faults

GeneralFlt (Off/On)
 CHWVFlt (Off/On)
 PwrFlt (Off/On)
 TmpFlt (Off/On)
 AirFlwFlt (Off/On)
 SATmpFlt (Off/On)
 RATmpFlt (Off/On)
 ZnTmpFlt (Off/On)
 OATmpFlt (Off/On)
 RARElHumFlt (Off/On)
 FanFlt (Off/On)
 CmpFlt (Off/On)
 FireAlm (Off/On)
 ExtDmpPosFlt (Off/On)
 WtrLeakFlt (Off/On)

Warnings

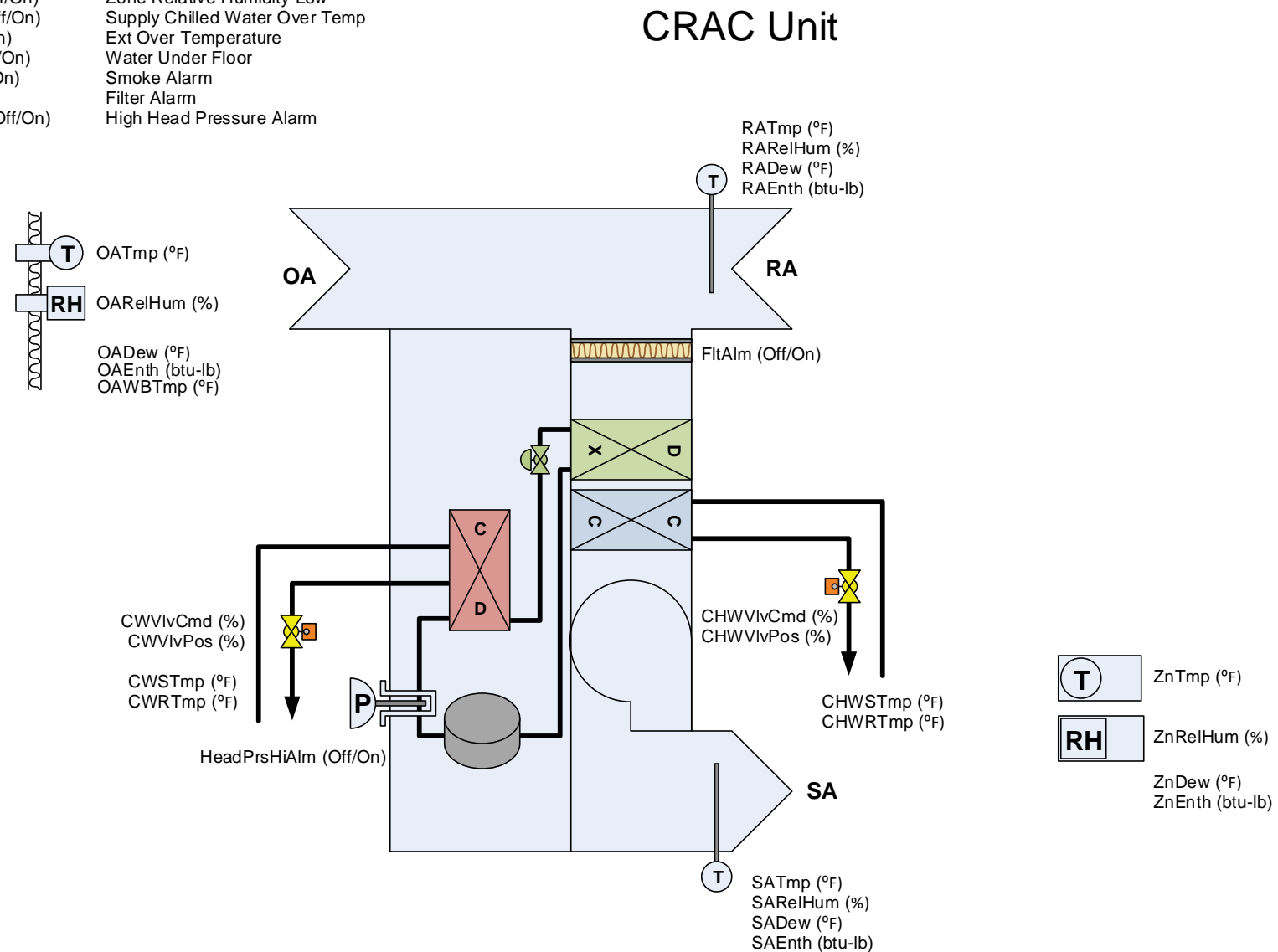
MaintDue (Off/On)
 ServiceReq (Off/On)
 SATmpHi (Off/On)
 SATmpLo (Off/On)
 RATmpHi (Off/On)
 RATmpLo (Off/On)
 ZnTmpHi (Off/On)
 ZnTmpLo (Off/On)
 RADewHi (Off/On)
 RADewLo (Off/On)
 RARElHumHi (Off/On)
 RARElHumLo (Off/On)
 ZnDewHi (Off/On)
 ZnDewLo (Off/On)
 ZnRelHumHi (Off/On)
 ZnRelHumLo (Off/On)
 CHWSTmpHi (Off/On)
 ExtTtmpHi (Off/On)
 WtrUdrFirFlt (Off/On)
 SmokeAlm (Off/On)
 FltAlm (Off/On)
 HeadPrsHiAlm (Off/On)

Description

General Fault
 Chilled Water Control Valve Failure
 Ext Power Source Failure
 Temperature Control Sensor Issue
 Airflow Sensor Issue
 Supply Air Sensor Issue
 Return Air Sensor Issue
 Ext Air Sensor Issue
 Outside Air Sensor Issue
 Return Air Relative Humidity Sensor Issue
 Fan Failure
 Compressor Failure
 External Fire Alarm Contacts
 External Air Damper Position Issue
 Water Leakage Detector Sensor Issue

Description

Maintenance Due
 Service Required
 Supply Air Over Temperature
 Supply Air Under Temperature
 Return Air Over Temperature
 Return Air Under Temperature
 Ext Air Sensor Over Temperature
 Ext Air Sensor Under Temperature
 Return Air Dew Point High
 Return Air Dew Point High
 Return Air Relative Humidity High
 Return Air Relative Humidity Low
 Zone Dew Point High
 Zone Dew Point Low
 Zone Relative Humidity High
 Zone Relative Humidity Low
 Supply Chilled Water Over Temp
 Ext Over Temperature
 Water Under Floor
 Smoke Alarm
 Filter Alarm
 High Head Pressure Alarm



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
-	-	-
-	-	-
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STATUS: Version 1.0

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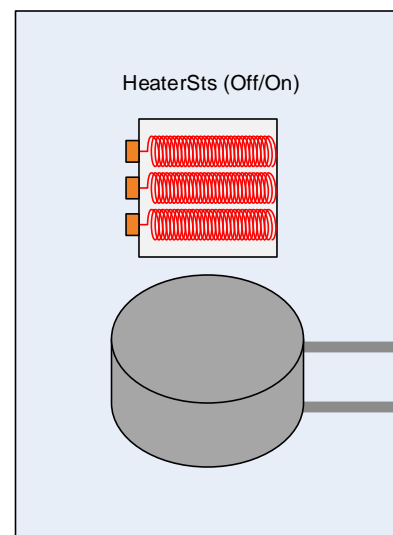
REV. DATE: 1/20/16

SHEET TITLE & NUMBER:

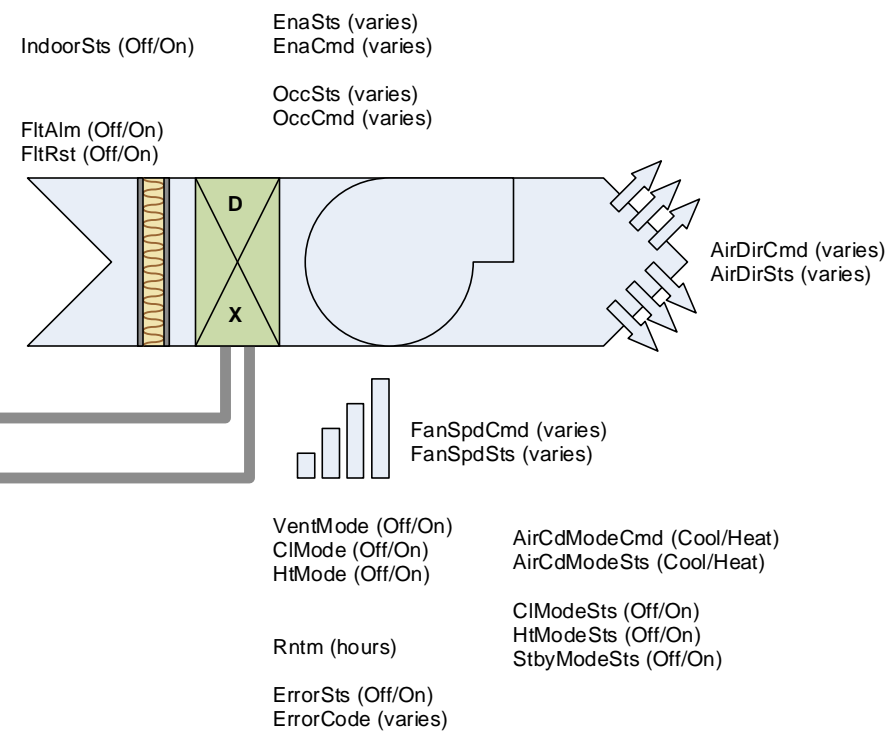
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CRAC

VRV Outdoor Unit



VRV Indoor Unit



- T** RmTmp (°F)
- RmTmpSp (°F)
- RmTmpDualSp (Off/On)
- OccClgSp (°F)
- OccHtgSp (°F)
- OpModeSts (varies)
- OpModeCmd (varies)

#	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

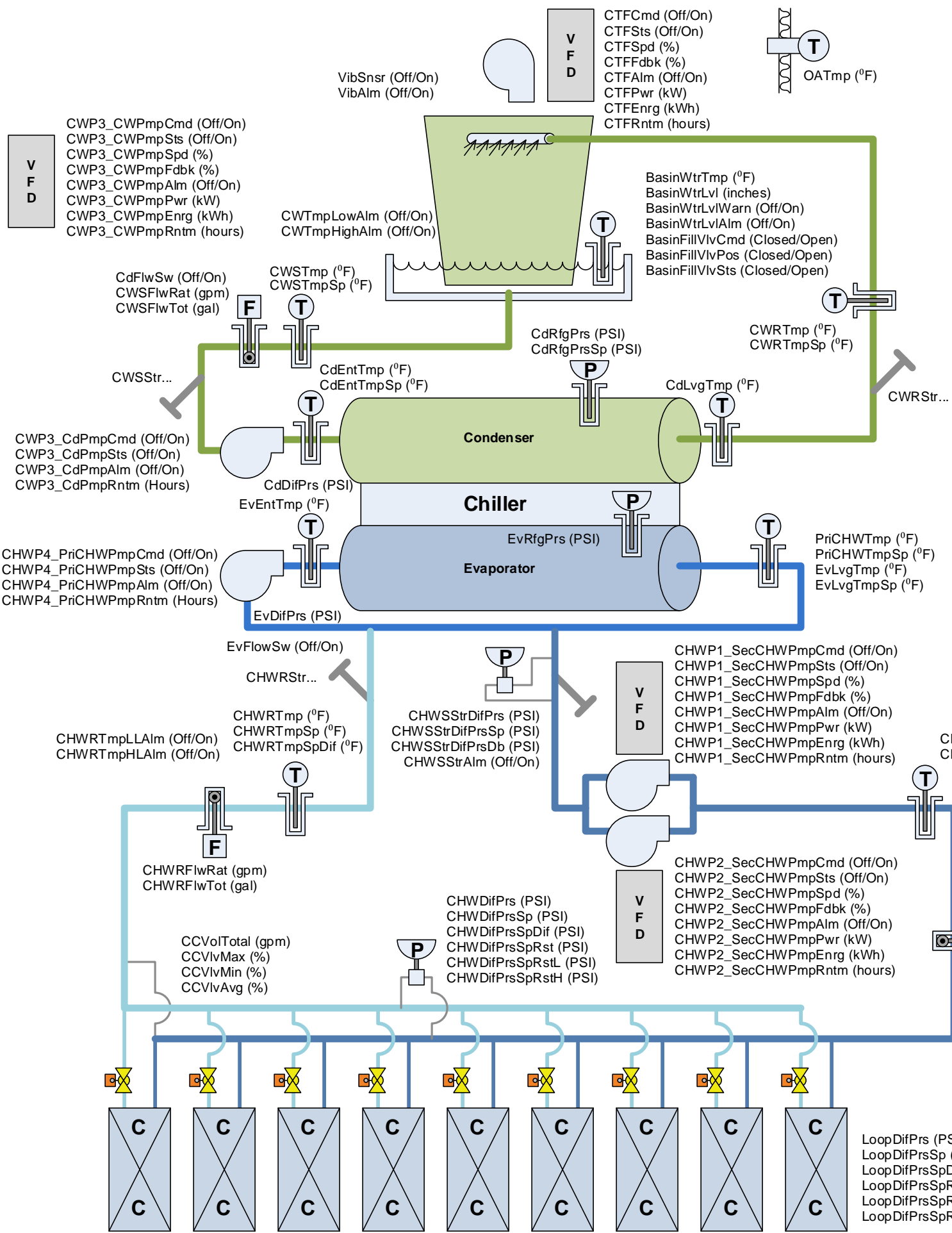
STATUS: Version 1.0

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- CWP3_CWPmpCmd (Off/On)
- CWP3_CWPmpSts (Off/On)
- CWP3_CWPmpSpd (%)
- CWP3_CWPmpFdbk (%)
- CWP3_CWPmpAlm (Off/On)
- CWP3_CWPmpPwr (kW)
- CWP3_CWPmpEnrg (kWh)
- CWP3_CWPmpRntm (hours)

- VibSnsr (Off/On)
- VibAlm (Off/On)

- CTFCmd (Off/On)
- CTFSts (Off/On)
- CTFSpd (%)
- CTFFdbk (%)
- CTFAlm (Off/On)
- CTFPwr (kW)
- CTFEnrg (kWh)
- CTFRntm (hours)

- BasinWtrTmp (°F)
- BasinWtrLvl (inches)
- BasinWtrLvlWarn (Off/On)
- BasinWtrLvlAlm (Off/On)
- BasinFillVlvCmd (Closed/Open)
- BasinFillVlvPos (Closed/Open)
- BasinFillVlvSts (Closed/Open)

- CdFlwSw (Off/On)
- CWSFlwRat (gpm)
- CWSFlwTot (gal)

- CWSTmp (°F)
- CWSTmpSp (°F)

- CdRfgPrs (PSI)
- CdRfgPrsSp (PSI)

- CdEntTmp (°F)
- CdEntTmpSp (°F)

- CdLvgTmp (°F)

- CWP3_CdPmpCmd (Off/On)
- CWP3_CdPmpSts (Off/On)
- CWP3_CdPmpAlm (Off/On)
- CWP3_CdPmpRntm (Hours)

- EvEntTmp (°F)

- CHWP4_PriCHWPmpCmd (Off/On)
- CHWP4_PriCHWPmpSts (Off/On)
- CHWP4_PriCHWPmpAlm (Off/On)
- CHWP4_PriCHWPmpRntm (Hours)

- EvDifPrs (PSI)

- EvFlowSw (Off/On)

- CHWRStr...

- CHWRTmpLLAlm (Off/On)
- CHWRTmpHLAlm (Off/On)

- CHWRTmp (°F)
- CHWRTmpSp (°F)
- CHWRTmpSpDif (°F)

- CHWSStrDifPrs (PSI)
- CHWSStrDifPrsSp (PSI)
- CHWSStrDifPrsDb (PSI)
- CHWSStrAlm (Off/On)

- CHWRFlwRat (gpm)
- CHWRFlwTot (gal)

- CCVolTotal (gpm)
- CCVlvMax (%)
- CCVlvMin (%)
- CCVlvAvg (%)

- CHWDifPrs (PSI)
- CHWDifPrsSp (PSI)
- CHWDifPrsSpDif (PSI)
- CHWDifPrsSpRst (PSI)
- CHWDifPrsSpRstL (PSI)
- CHWDifPrsSpRstH (PSI)

- CHWP1_SecCHWPmpCmd (Off/On)
- CHWP1_SecCHWPmpSts (Off/On)
- CHWP1_SecCHWPmpSpd (%)
- CHWP1_SecCHWPmpFdbk (%)
- CHWP1_SecCHWPmpAlm (Off/On)
- CHWP1_SecCHWPmpPwr (kW)
- CHWP1_SecCHWPmpEnrg (kWh)
- CHWP1_SecCHWPmpRntm (hours)

- CHWSTmpLowAlm (Off/On)
- CHWSTmpHighAlm (Off/On)

- CHWSTmp (°F)
- CHWSTmpSp (°F)
- CHWSTmpSpDif (°F)
- CHWSTmpSpRst (°F)
- CHWSTmpSpRstL (°F)
- CHWSTmpSpRstH (°F)

- CHWP2_SecCHWPmpCmd (Off/On)
- CHWP2_SecCHWPmpSts (Off/On)
- CHWP2_SecCHWPmpSpd (%)
- CHWP2_SecCHWPmpFdbk (%)
- CHWP2_SecCHWPmpAlm (Off/On)
- CHWP2_SecCHWPmpPwr (kW)
- CHWP2_SecCHWPmpEnrg (kWh)
- CHWP2_SecCHWPmpRntm (hours)

- CHWSFlwRat (gpm)
- CHWSFlwTot (gal)

- CHWEnrgRat (energy units)
- CHWEnrgTot (energy units)
- CHWTons (tons)
- CHWkWTon (kW/ton)
- CHWBtuRat (btu/hr, kbtu/hr, mbtu/hr)
- CHWBtuTot (btu, kbtu, mbtu)
- CHWBtuKWh (btu/kWh)
- CHWTonsSqFt (tons/sqft)
- CHWBtuHrSqFt (btu/hr/sqft)
- CHWCapacity (tons, btu, kbtu, mbtu, kW)

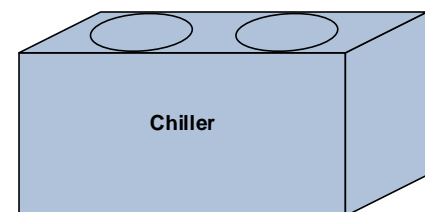
- LoopDifPrs (PSI)
- LoopDifPrsSp (PSI)
- LoopDifPrsSpDif (PSI)
- LoopDifPrsSpRst (PSI)
- LoopDifPrsSpRstL (PSI)
- LoopDifPrsSpRstH (PSI)

- PriCHWPmpSeq (seq)
- PriCHWPmpLeadEna (Off/On)
- PriCHWPmpLagEna (Off/On)
- PriCHWPmpEna (Off/On)
- PriCHWPmpCmd (Off/On)
- PriCHWPmpSts (Off/On)

- SecCHWPmpSeq (seq)
- SecCHWPmpLeadEna (Off/On)
- SecCHWPmpLagEna (Off/On)
- SecCHWPmpEna (Off/On)
- SecCHWPmpCmd (Off/On)
- SecCHWPmpSts (Off/On)

- CdPmpEna (Off/On)
- CdPmpCmd (Off/On)
- CdPmpSts (Off/On)
- CirPmpEna (Off/On)
- CirPmpCmd (Off/On)
- CirPmpSts (Off/On)

Air-Cooled Chiller



- ChlrStg1Ena (Off/On)
- ChlrStg1Cmd (Off/On)
- ChlrStg1Sts (Off/On)
- ChlrStg2Ena (Off/On)
- ChlrStg2Cmd (Off/On)
- ChlrStg2Sts (Off/On)

- Cmp1Ena (Off/On)
- Cmp1Cmd (Off/On)
- Cmp1Sts (Off/On)
- Cmp2Ena (Off/On)
- Cmp2Cmd (Off/On)
- Cmp2Sts (Off/On)

- CHWRTmp (°F)
- CHWRTmpSp (°F)

- IsoVlvCmd (Closed/Open)
- IsoVlvPos (Closed/Open)
- IsoVlvSts (Closed/Open)

- CircPmpCmd (Off/On)
- CircPmpSts (Off/On)
- CircPmpSpd (%)
- CircPmpFdbk (%)
- CircPmpAlm (Off/On)
- CircPmpPwr (kW)
- CircPmpEnrg (kWh)
- CircPmpRntm (hours)

- CHWSTmp (°F)
- CHWSTmpSp (°F)

Chillerplant Control Objects

- CHWSysEna (Off/On)
- CIDcmd (Off/On)
- CLckCmd (Off/On)
- CLckSts (Off/On)
- OALckTmpSp (°F)
- OALckTmpDb (°F)
- OARstTmpSpL (°F)
- OARstTmpSpH (°F)

Chiller Objects

- CHL01_ChlrEna (Off/On)
- CHL01_ChlrCmd (Off/On)
- CHL01_ChlrSts (Off/On)
- CHL01_ChlrAlm (Off/On)
- CHL01_ChlrPwr (kW)
- CHL01_ChlrEnrg (kWh)
- CHL01_ChlrLoad (tons)
- CHL01_ChlrLmtPwr (kW)
- CHL01_ChlrSeq (seq)
- CHL01_ChlrLeadEna (Off/On)
- CHL01_ChlrLagEna (Off/On)
- CHL01_ChlrCap (Tons, btu, mbtu)
- CHL01_ChlrLmtPct (%)
- CHL01_ChlrLmtActive (Off/On)
- CHL01_ChlrLocRem (Loc/Rem)
- CHL01_ChlrActCapPct (%)
- CHL01_ChlrRunMode (varies)
- CHL01_ChlrOperMode (varies)
- CHL01_ChlrSpCtrlEna (Off/On)
- CHL01_ChlrSpCtrl (local/remote)
- CHL01_CdFlwSw (Off/On)
- CHL01_EvFlwSw (Off/On)
- CHL01_HeadPrsAlm (Off/On)
- CHL01_HeadPrsLmt (PSI)
- CHL01_CdPmpReq (req)
- CHL01_PriPmpReq (req)
- CHL01_CurLmtSp (Amps)

- Ckt1EvPrs (PSI)
- Ckt1CdPrs (PSI)
- Ckt1EvRfgPrs (PSI)
- Ckt1CdRfgTmp (°F)
- Ckt1EvRfgTmp (°F)
- Ckt1RfgDisTmp (°F)
- Ckt2EvPrs (PSI)
- Ckt2CdPrs (PSI)
- Ckt2EvRfgPrs (PSI)
- Ckt2CdRfgTmp (°F)
- Ckt2EvRfgTmp (°F)
- Ckt2RfgDisTmp (°F)

- C1CmpStrts (starts)
- C1CmpRntm (hours)
- C1OilPrs (PSI)
- C2CmpStrts (starts)
- C2CmpRntm (hours)
- C2OilPrs (PSI)

Pump Control Objects

- PriPmpSeq (seq)
- PriPmpLeadEna (Off/On)
- PriPmpLagEna (Off/On)
- PriPmpEna (Off/On)
- PriPmpCmd (Off/On)
- PriPmpSts (Off/On)
- SecPmpSeq (seq)
- SecPmpLeadEna (Off/On)
- SecPmpLagEna (Off/On)
- SecPmpEna (Off/On)
- SecPmpCmd (Off/On)
- SecPmpSts (Off/On)

PROJECT

BAS Object Naming Standard
Equipment Schematics

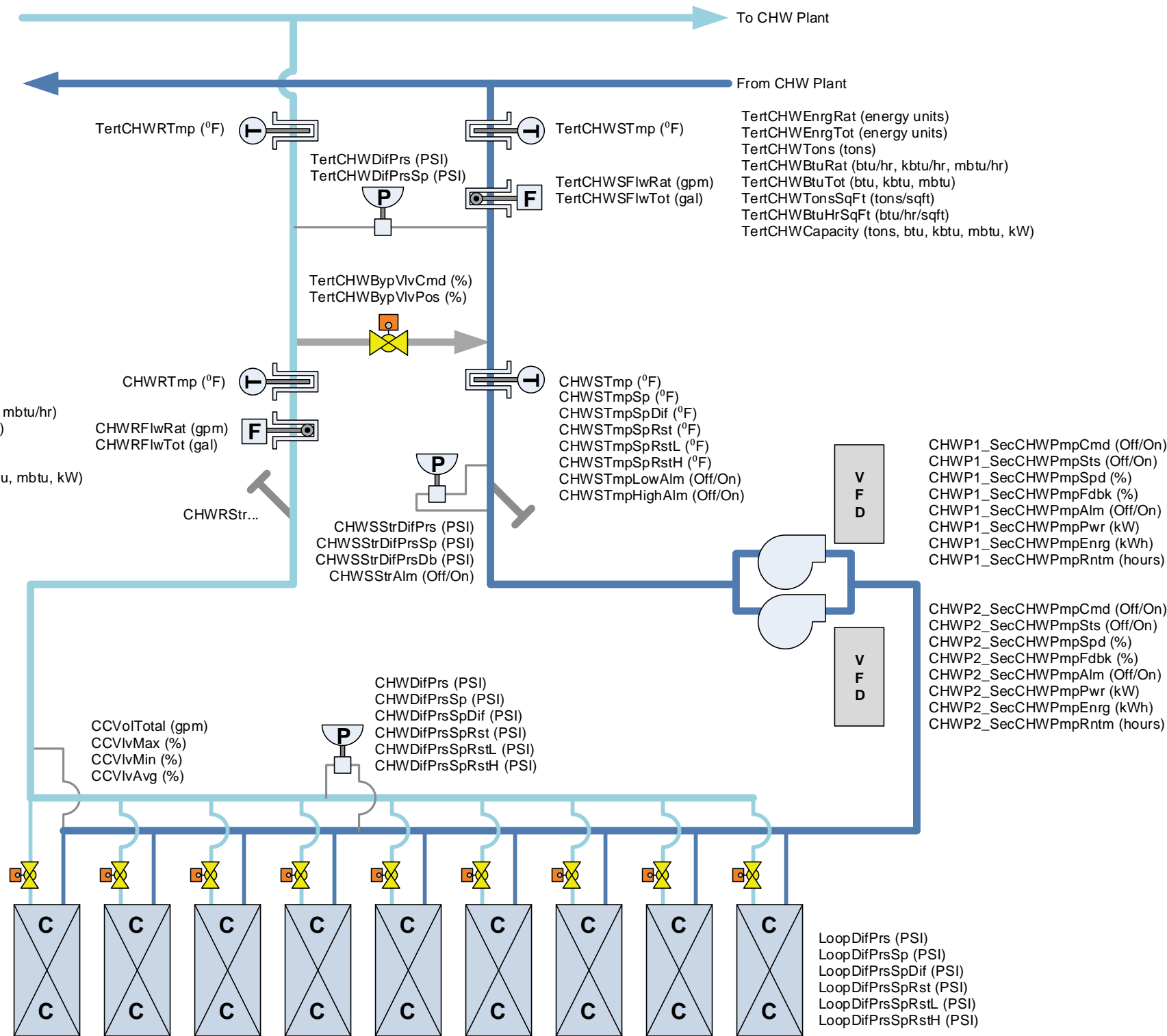
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STATUS: Version 1.0
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REV. DATE: 1/20/16

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CHWS1

Tertiary CHW



CHWEngRat (energy units)
 CHWEngTot (energy units)
 CHWTons (tons)
 CHWBtuRat (btu/hr, kbtu/hr, mbtu/hr)
 CHWBtuTot (btu, kbtu, mbtu)
 CHWTonsSqFt (tons/sqft)
 CHWBtuHrSqFt (btu/hr/sqft)
 CHWCapacity (tons, btu, kbtu, mbtu, kW)

CHWRTmp (°F)
 CHWRFlwRat (gpm)
 CHWRFlwTot (gal)
 CHWRStr...

CHWSStrDifPrs (PSI)
 CHWSStrDifPrsSp (PSI)
 CHWSStrDifPrsDb (PSI)
 CHWSStrAlm (Off/On)

CCVolTotal (gpm)
 CCVlvMax (%)
 CCVlvMin (%)
 CCVlvAvg (%)

CHWDifPrs (PSI)
 CHWDifPrsSp (PSI)
 CHWDifPrsSpDif (PSI)
 CHWDifPrsSpRst (PSI)
 CHWDifPrsSpRstL (PSI)
 CHWDifPrsSpRstH (PSI)

TertCHWEngRat (energy units)
 TertCHWEngTot (energy units)
 TertCHWTons (tons)
 TertCHWBtuRat (btu/hr, kbtu/hr, mbtu/hr)
 TertCHWBtuTot (btu, kbtu, mbtu)
 TertCHWTonsSqFt (tons/sqft)
 TertCHWBtuHrSqFt (btu/hr/sqft)
 TertCHWCapacity (tons, btu, kbtu, mbtu, kW)

TertCHWDifPrs (PSI)
 TertCHWDifPrsSp (PSI)
 TertCHWSFlwRat (gpm)
 TertCHWSFlwTot (gal)

TertCHWByvVlvCmd (%)
 TertCHWByvVlvPos (%)

CHWSTmp (°F)
 CHWSTmpSp (°F)
 CHWSTmpSpDif (°F)
 CHWSTmpSpRst (°F)
 CHWSTmpSpRstL (°F)
 CHWSTmpSpRstH (°F)
 CHWSTmpLowAlm (Off/On)
 CHWSTmpHighAlm (Off/On)

CHWP1_SecCHWPmpCmd (Off/On)
 CHWP1_SecCHWPmpSts (Off/On)
 CHWP1_SecCHWPmpSpd (%)
 CHWP1_SecCHWPmpFdbk (%)
 CHWP1_SecCHWPmpAlm (Off/On)
 CHWP1_SecCHWPmpPwr (kW)
 CHWP1_SecCHWPmpEnrg (kWh)
 CHWP1_SecCHWPmpRntm (hours)

CHWP2_SecCHWPmpCmd (Off/On)
 CHWP2_SecCHWPmpSts (Off/On)
 CHWP2_SecCHWPmpSpd (%)
 CHWP2_SecCHWPmpFdbk (%)
 CHWP2_SecCHWPmpAlm (Off/On)
 CHWP2_SecCHWPmpPwr (kW)
 CHWP2_SecCHWPmpEnrg (kWh)
 CHWP2_SecCHWPmpRntm (hours)

LoopDifPrs (PSI)
 LoopDifPrsSp (PSI)
 LoopDifPrsSpDif (PSI)
 LoopDifPrsSpRst (PSI)
 LoopDifPrsSpRstL (PSI)
 LoopDifPrsSpRstH (PSI)

See other CHWS pages for additional CHWS objects.

PROJECT

BAS Object Naming Standard

Equipment Schematics

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STATUS: Version 1.0

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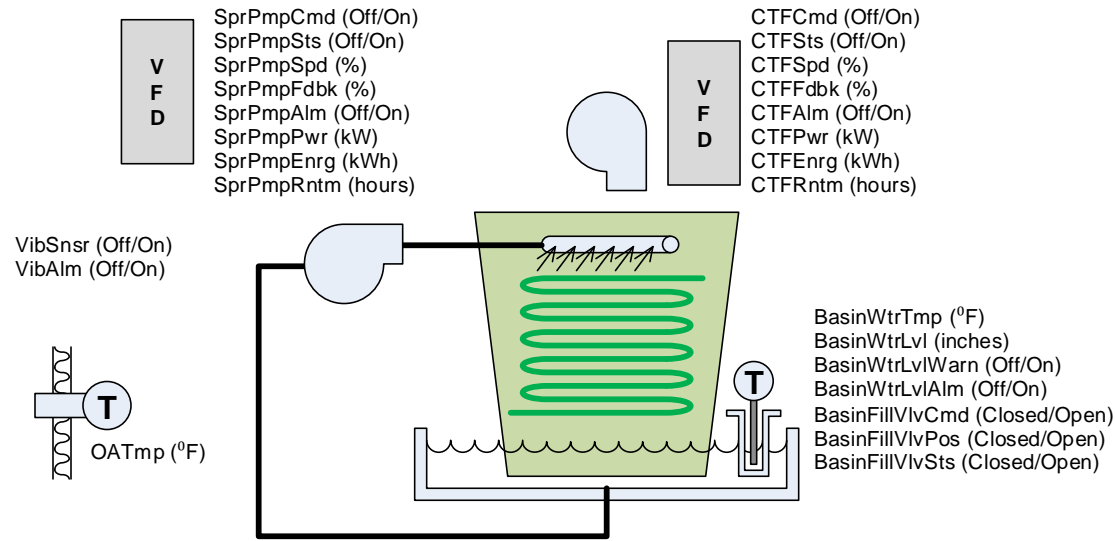
CHWS2

Condenser System Energy

- CWEngRat (energy units)
- CWEngTot (energy units)
- CWTons (tons)
- CWkWTon (kW/ton)
- CWBtuRat (btu/hr, kbtu/hr, mbtu/hr)
- CWBtuTot (btu, kbtu, mbtu)
- CWBtukWh (btu/kWh)
- CWTonsSqFt (tons/sqft)
- CWBtuHrSqFt (btu/hr/sqft)
- CWCapacity (tons, btu, kbtu, mbtu, kW)

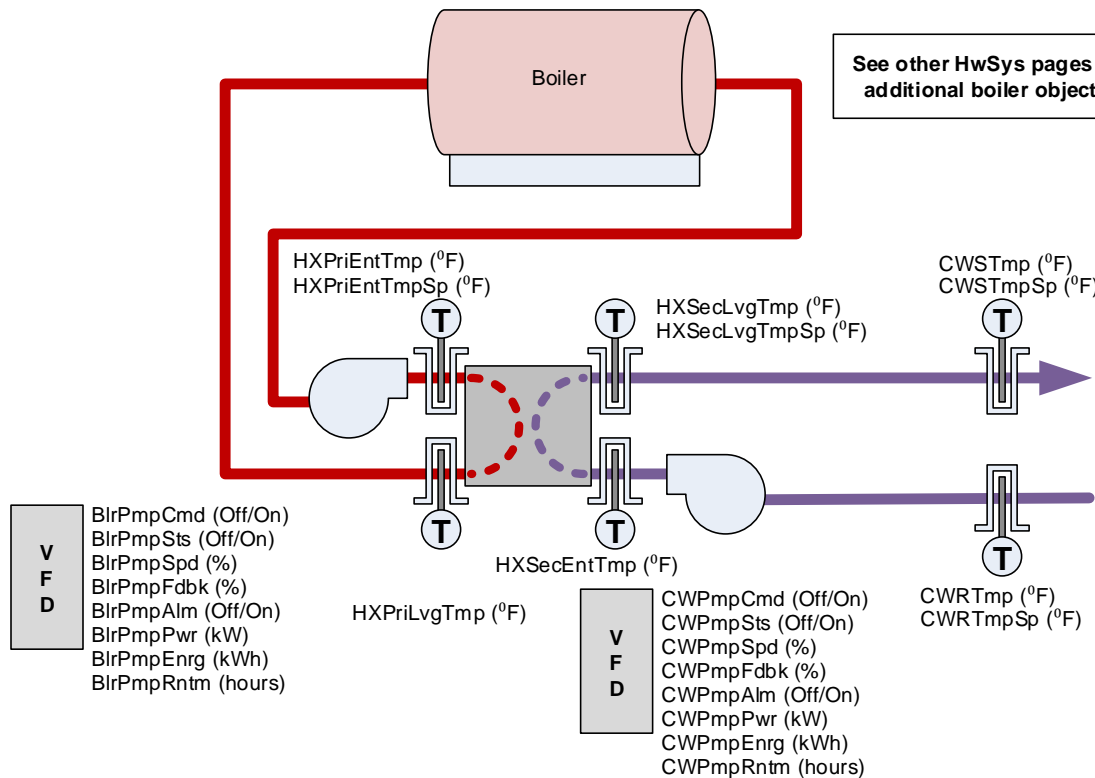
Closed-Loop Cooling Tower

For open-loop cooling tower, see ChwSys page.

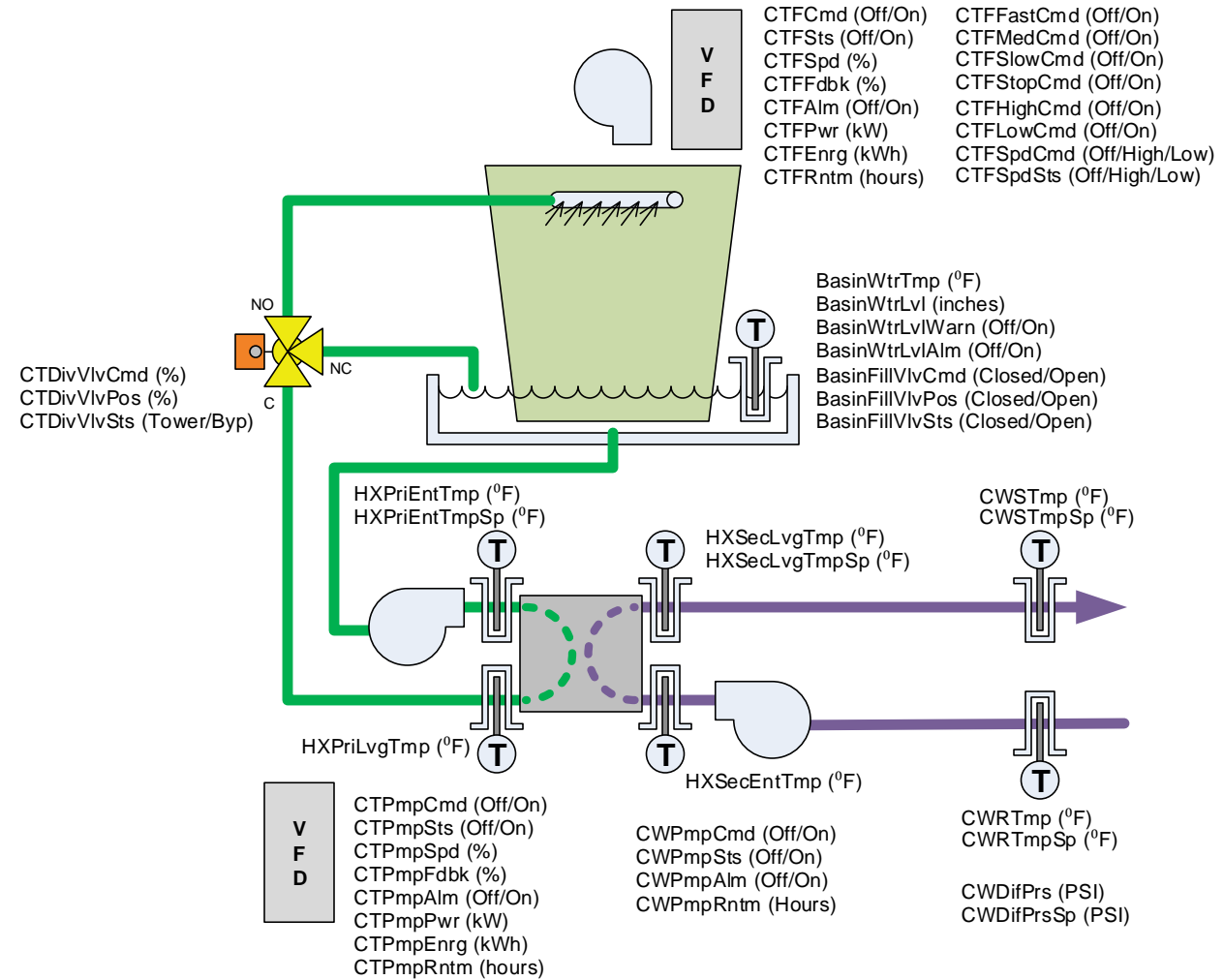


Condenser HW Water System

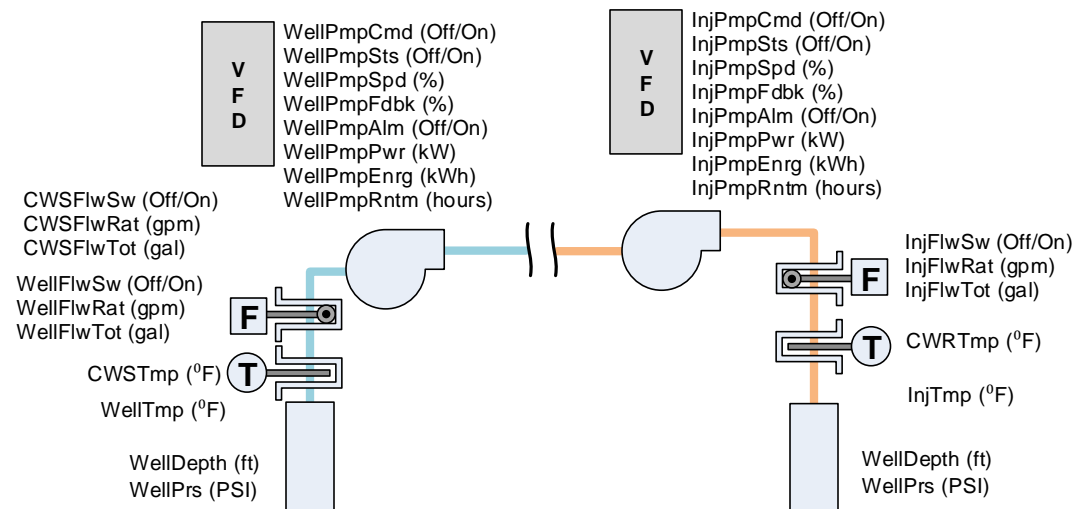
See other HwSys pages for additional boiler objects.



Condenser Water System/ Evaporative Cooling System



Geothermal Condenser Water System



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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STATUS: Version 1.0

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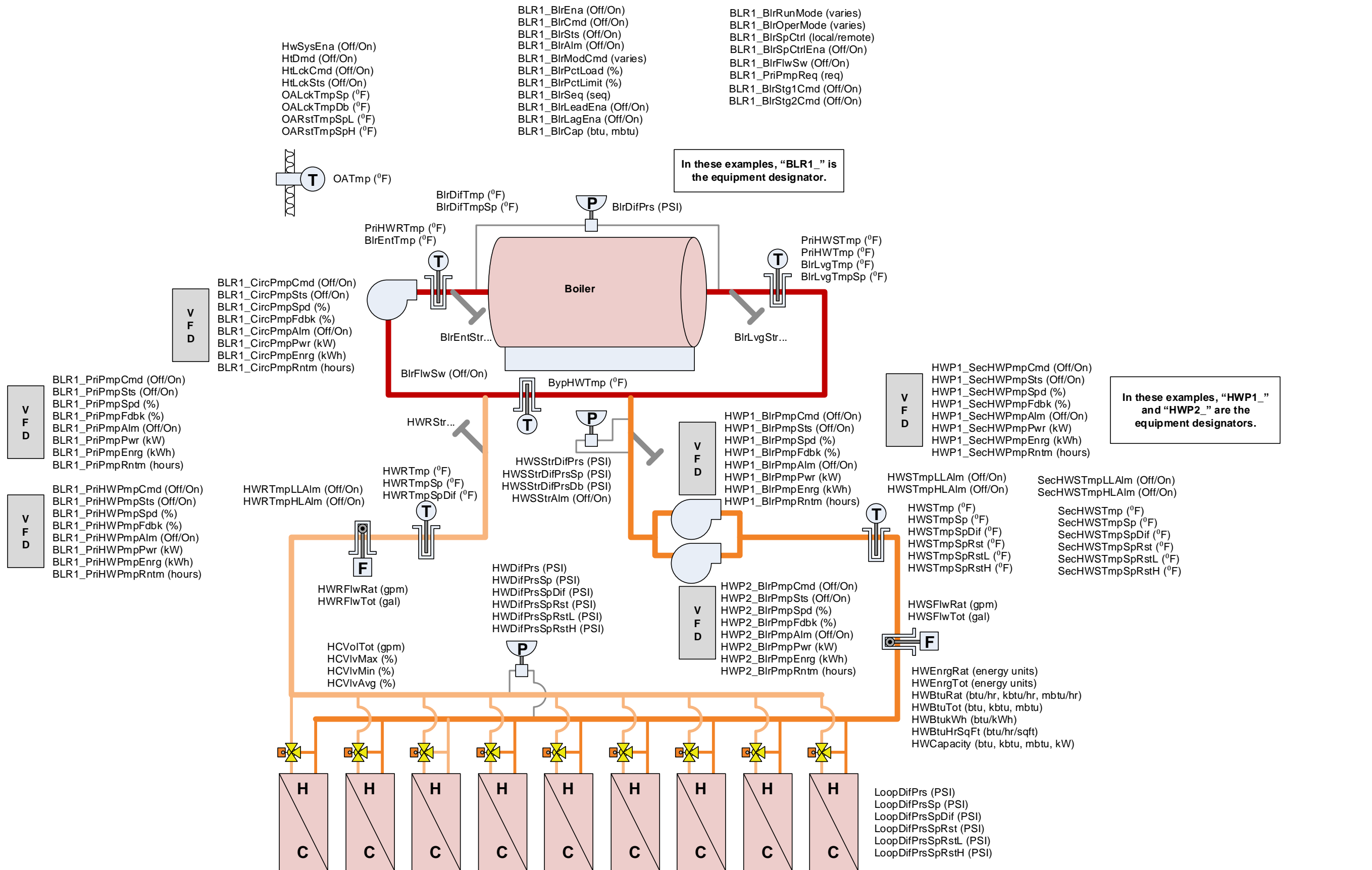
REV. DATE: 1/20/16

SHEET TITLE & NUMBER:

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CWS

Heating Hot Water System



PROJECT

BAS Object Naming Standard

Equipment Schematics

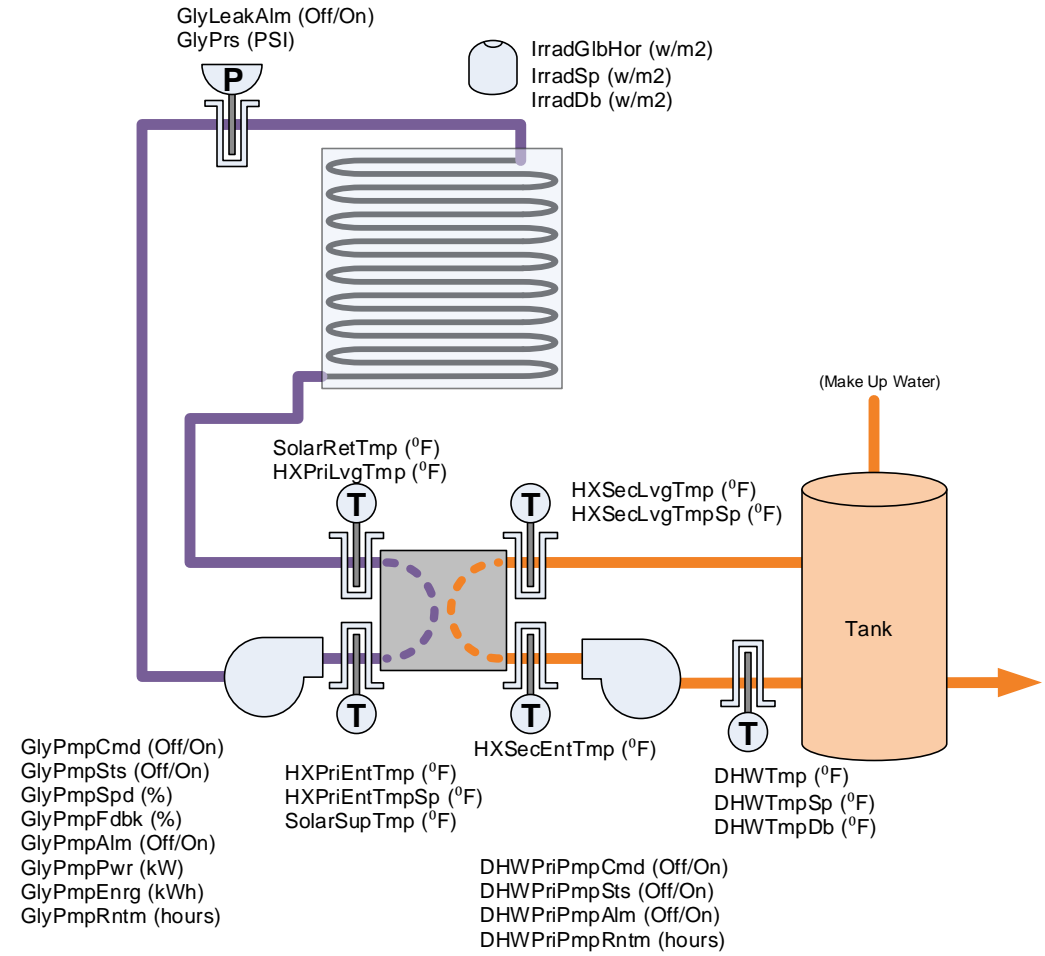
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STATUS: Version 1.0
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 REV. DATE: 1/20/16

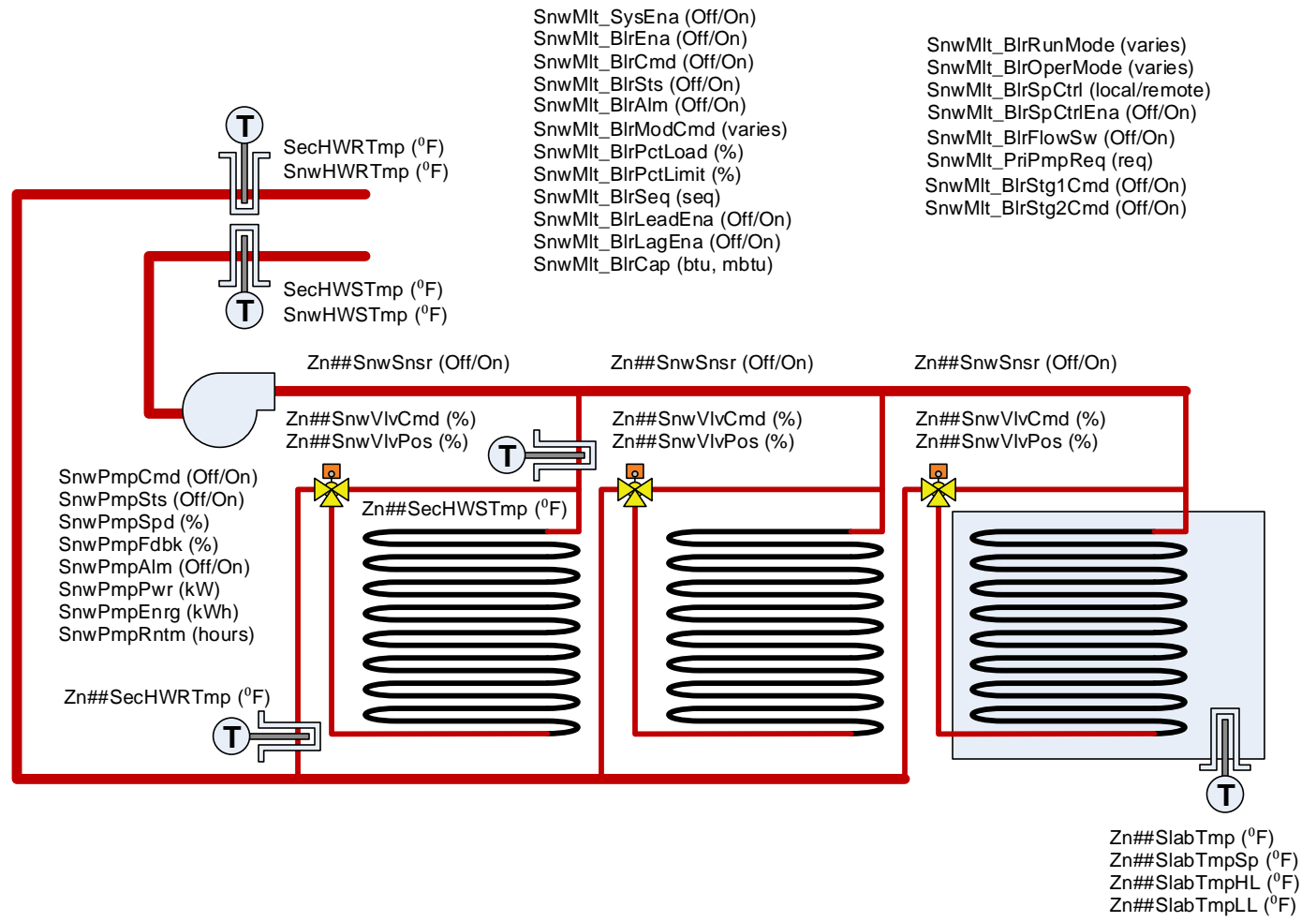
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HWS1

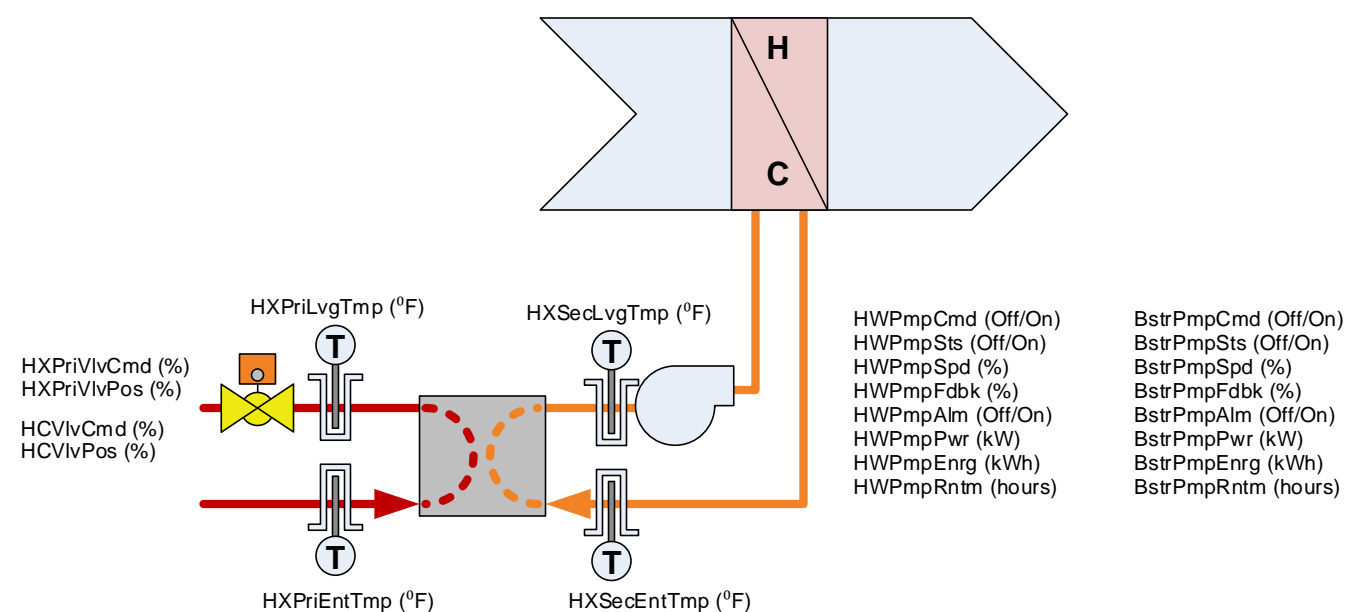
Solar Thermal Hot Water



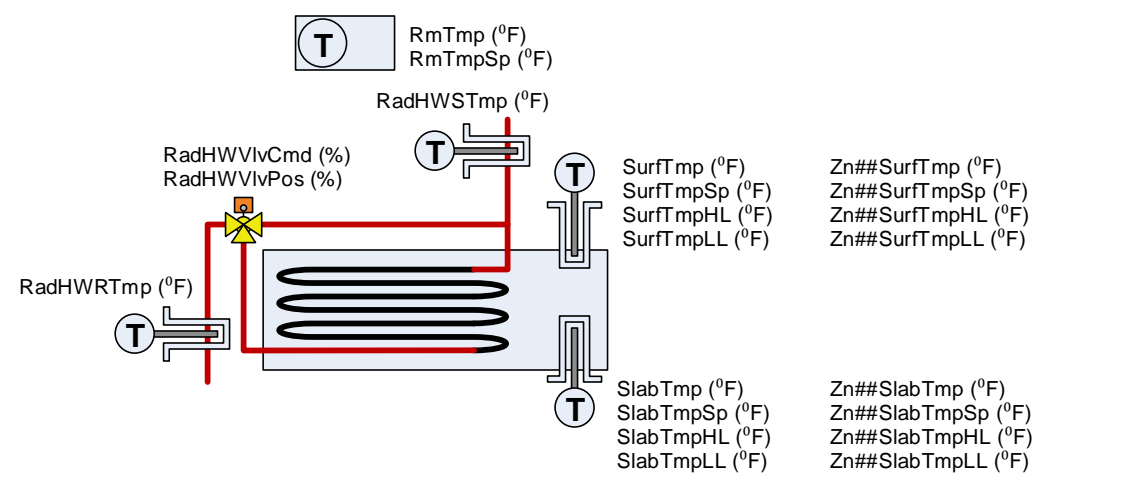
Snow Melt System



HW HX & Booster Pump



Radiant Floor Heat



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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STATUS: Version 1.0

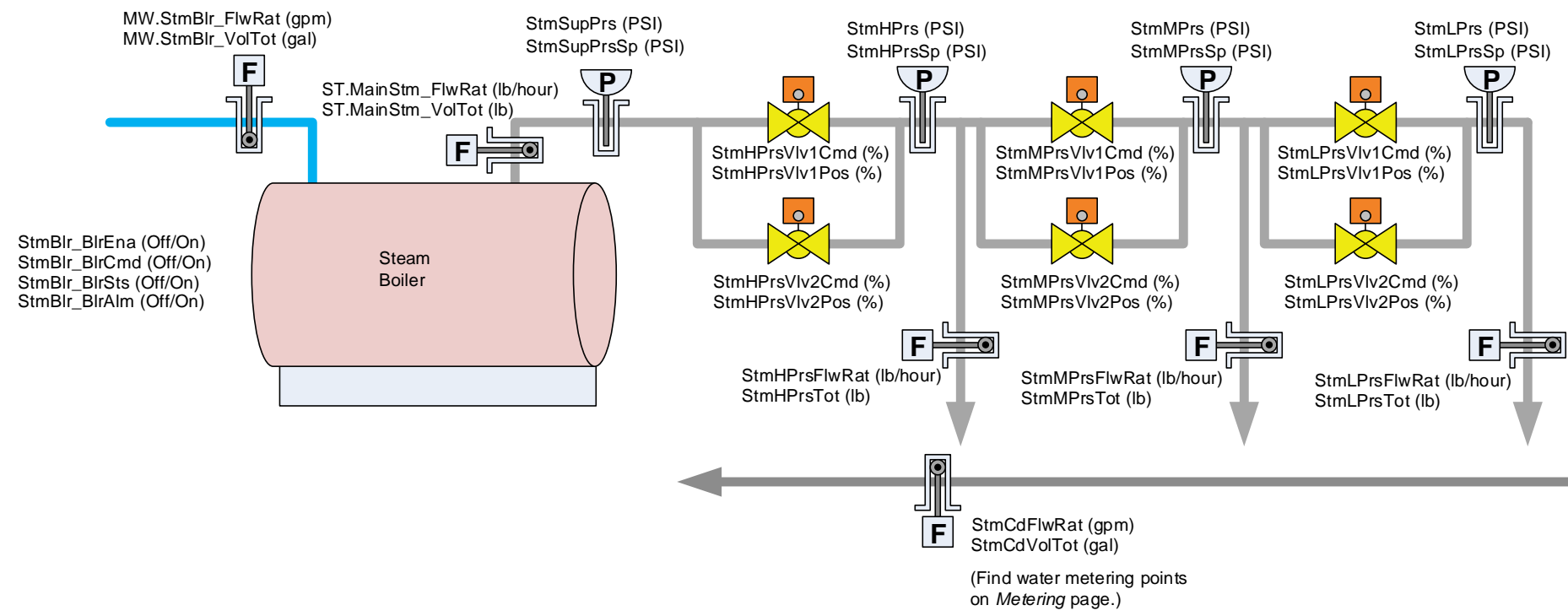
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REV. DATE: 1/20/16

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Steam Boiler

Steam Reduction Station



#	DATE	DESCRIPTION
-	-	-
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STATUS: Version 1.0

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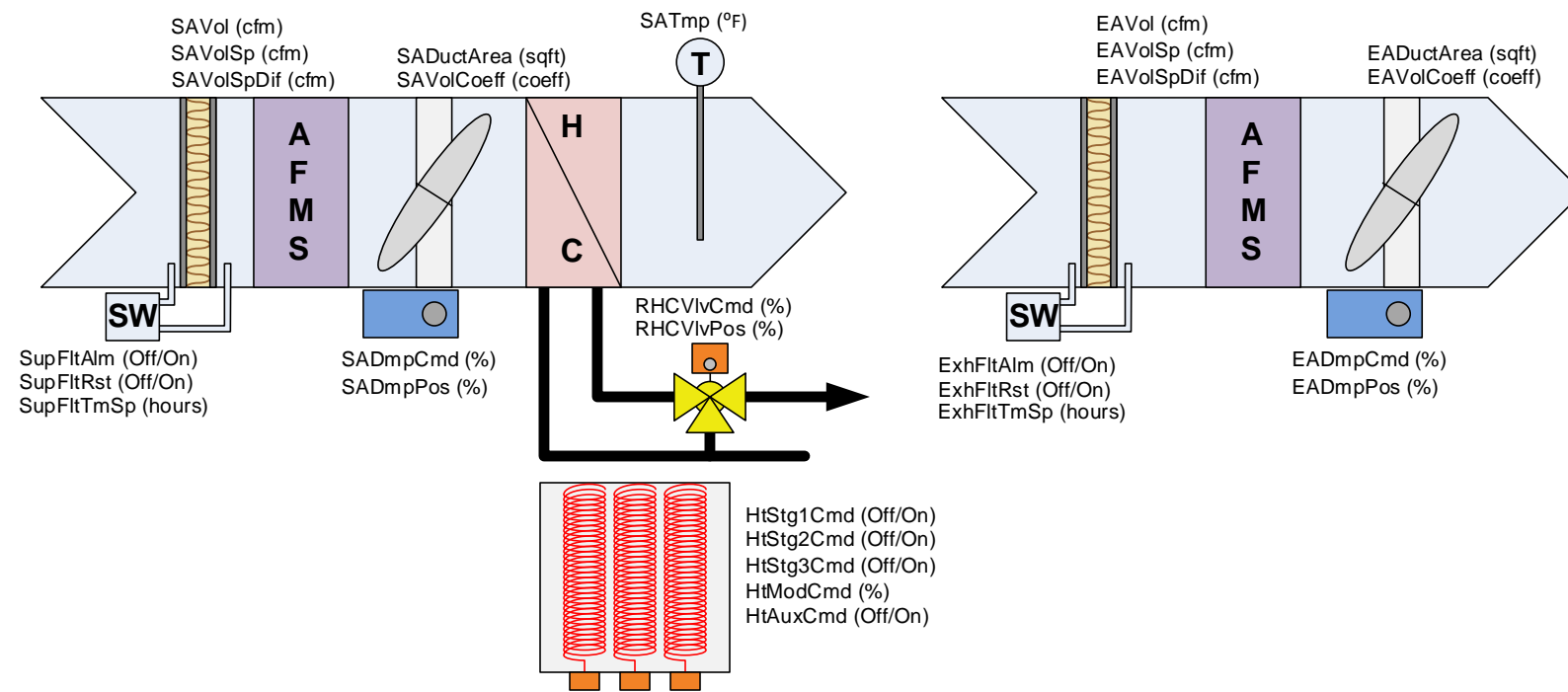
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SHEET TITLE & NUMBER:

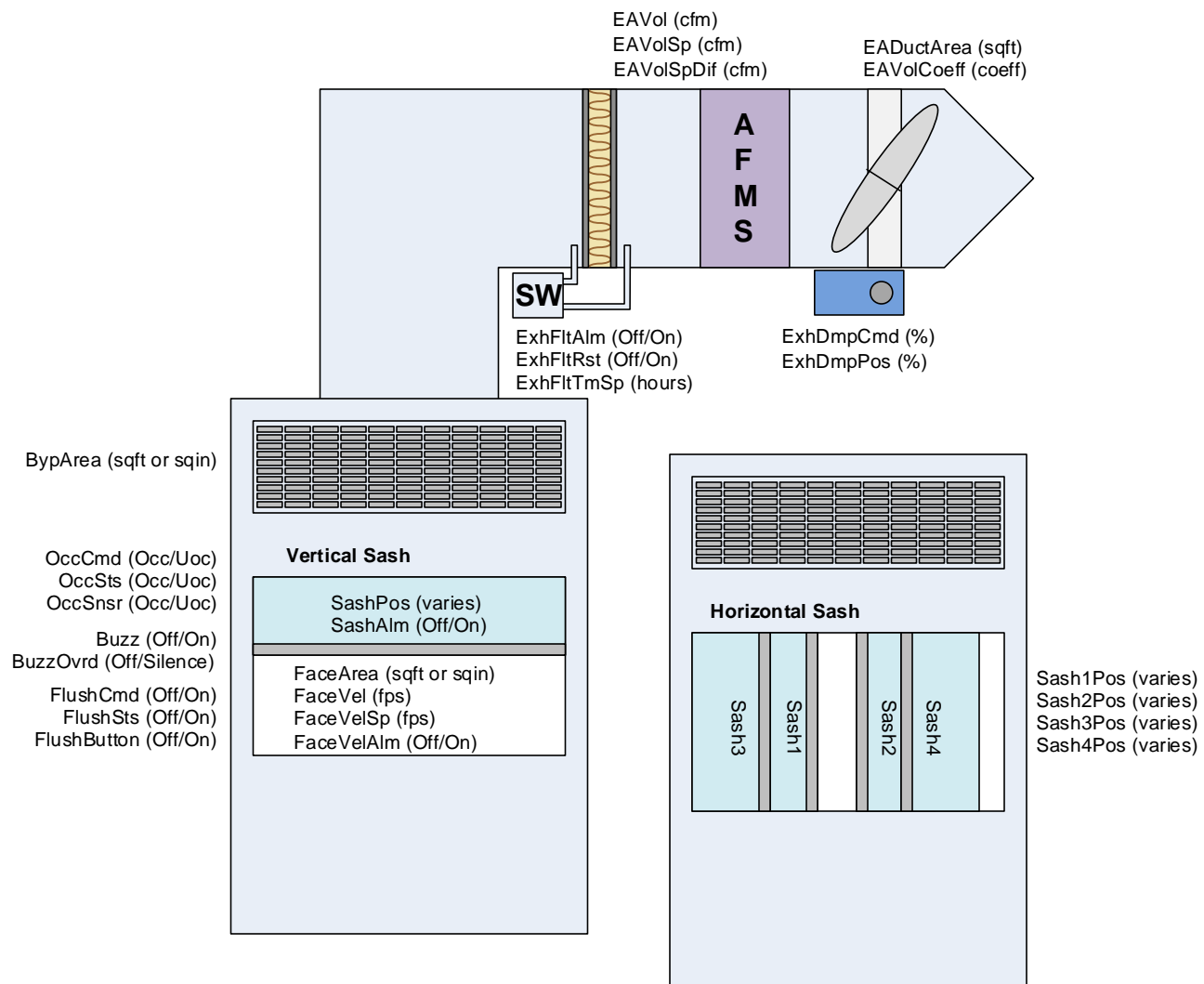
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STM

Lab Room Terminal Unit Objects



Fume Hood Objects



Lab Room Control System Objects

- | | | |
|------------------------|---------------------------|---------------------------|
| OccSnsr (Occ/Uoc) | IsoModeCmd (neut/pro/inf) | SupAirVolTot (cfm) |
| OccCmd (Occ/Uoc) | IsoModeSts (neut/pro/inf) | SupAirVolTotSp (cfm) |
| OccSts (Occ/Uoc) | PrsModeCmd (neut/pos/neg) | EAVolTot (cfm) |
| OccOvrd (Uoc/Ovrd) | PrsModeSts (neut/pos/neg) | EAVolTotSp (cfm) |
| FlushCmd (Off/On) | PrsAlm (Off/On) | DifVolTot (cfm) |
| FlushSts (Off/On) | PrsWam (Off/On) | DifVolTotSp (cfm) |
| FlushBtn (Off/On) | | SAVolSpMax (cfm) |
| DifVolAlm (Off/On) | RmTmp (°F) | SAVolSpMin (cfm) |
| SAVolAlm (Off/On) | EffRmTmpSp (°F) | EAVolSpMax (cfm) |
| EAVolAlm (Off/On) | OccRmTmpSp (°F) | EAVolSpMin (cfm) |
| Buzz (Off/On) | UnocRmTmpSp (°F) | TmpCtrlVol (cfm) |
| BuzzOvrd (Off/Silence) | OccClgSp (°F) | TrkModeCmd (none/ETS/STE) |
| DoorSw (Closed/Open) | OccHtgSp (°F) | TrkModeSts (none/ETS/STE) |
| DoorAlm (Off/On) | UnocClgSp (°F) | AirChgRat (cph) |
| | UnocHtgSp (°F) | AirChgRatSp (cph) |
| | | RmVol (cf) |

PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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STATUS: Version 1.0

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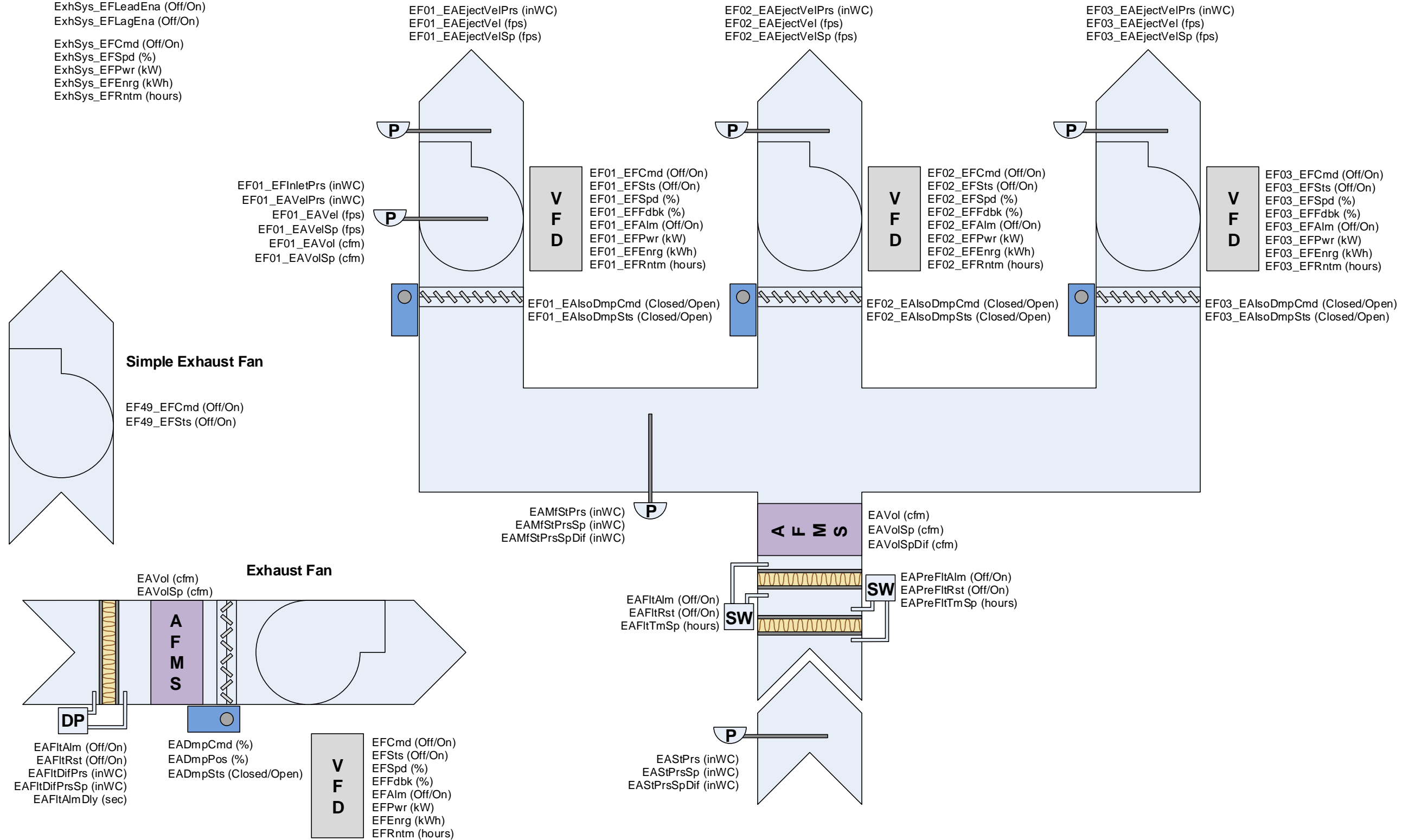
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LAB

Exhaust System Control Objects

- ExhSys_ExhEna (Off/On)
- ExhSys_EFRotCmd (Off/On)
- ExhSys_EFSeq (Seq)
- ExhSys_EFLeadEna (Off/On)
- ExhSys_EFLagEna (Off/On)
- ExhSys_EFCmd (Off/On)
- ExhSys_EFSpd (%)
- ExhSys_EFPwr (kW)
- ExhSys_EFEnrg (kWh)
- ExhSys_EFRntm (hours)

Exhaust Manifold System



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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STATUS: Version 1.0

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EXH

Lighting Panel EPLA

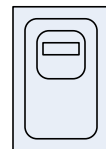
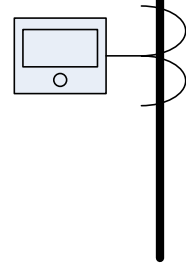
1	Rm0101_LgtCmd (Off/On)	EPLA01_BrkSts (Off/On/Trip)			EPLA02_BrkSts (Off/On/Trip)	Zn12_LgtCmd (Off/On)	2
3	Rm0102_LgtCmd (Off/On)	EPLA03_BrkSts (Off/On/Trip)			EPLA04_BrkSts (Off/On/Trip)	WHall_LgtCmd (Off/On)	4
5	Rm0103_LgtCmd (Off/On)	EPLA05_BrkSts (Off/On/Trip)			EPLA06_BrkSts (Off/On/Trip)	Cnf_LgtCmd (Off/On)	6
7	Rm0254_LgtCmd (Off/On)	EPLA07_BrkSts (Off/On/Trip)			EPLA08_BrkSts (Off/On/Trip)	Off400_LgtCmd (Off/On)	8
9	Rm0258_LgtCmd (Off/On)	EPLA09_BrkSts (Off/On/Trip)			EPLA10_BrkSts (Off/On/Trip)	Cpy_LgtCmd (Off/On)	10
11	Rm0844_LgtCmd (Off/On)	EPLA11_BrkSts (Off/On/Trip)			EPLA12_BrkSts (Off/On/Trip)	GymN_LgtCmd (Off/On)	12
13	Rm0845_LgtCmd (Off/On)	EPLA13_BrkSts (Off/On/Trip)			EPLA14_BrkSts (Off/On/Trip)	GymS_LgtCmd (Off/On)	14
15	Rm1012_LgtCmd (Off/On)	EPLA15_BrkSts (Off/On/Trip)			EPLA16_BrkSts (Off/On/Trip)	BbFld_LgtCmd (Off/On)	16
17	LbyCan_LgtCmd (Off/On)	EPLA17_BrkSts (Off/On/Trip)			EPLA18_BrkSts (Off/On/Trip)	LkrRm_LgtCmd (Off/On)	18
19	LbyAcc_LgtCmd (Off/On)	EPLA19_BrkSts (Off/On/Trip)			EPLA20_BrkSts (Off/On/Trip)	WdwCan_LgtCmd (Off/On)	20
21	LbyDpy_LgtCmd (Off/On)	EPLA21_BrkSts (Off/On/Trip)			EPLA22_BrkSts (Off/On/Trip)	WdwSpt_LgtCmd (Off/On)	22
23	Sgn_LgtCmd (Off/On)	EPLA23_BrkSts (Off/On/Trip)			EPLA24_BrkSts (Off/On/Trip)	Stage_LgtCmd (Off/On)	24
25	PkgN_LgtCmd (Off/On)	EPLA25_BrkSts (Off/On/Trip)			EPLA26_BrkSts (Off/On/Trip)	Stg_LgtCmd (Off/On)	26
27	PkgW_LgtCmd (Off/On)	EPLA27_BrkSts (Off/On/Trip)			EPLA28_BrkSts (Off/On/Trip)	Clr101_LgtCmd (Off/On)	28
29	ExtFnt_LgtCmd (Off/On)	EPLA29_BrkSts (Off/On/Trip)			EPLA30_BrkSts (Off/On/Trip)	Roof_LgtCmd (Off/On)	30
31	ExtBck_LgtCmd (Off/On)	EPLA31_BrkSts (Off/On/Trip)			EPLA32_BrkSts (Off/On/Trip)	LdgFld_LgtCmd (Off/On)	32

EPLA_LgtPnlSts (varies)
 EPLA_LgtPnlFlt (Off/On)
 EPLA_LgtPnlAlm (Off/On)

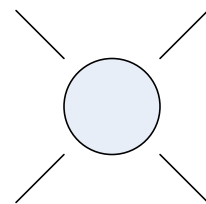
Lighting Abbreviations

Acc = Accent lights
 BbFld = Baseball Field
 Brk = Breaker
 Can = Can lights
 Clr = Classroom
 Cmd = Command
 Cnf = Conference Room
 Cpy = Copy Room
 Dpy = Display
 E = East
 Ena = Enable
 Ext = Exterior
 FbFld = Football Field
 Fld = Field/Flood lights
 Grp = Group
 Gym = Gymnasium
 Int = Interior
 Lby = Lobby
 Lck = Lockout
 Ldg = Loading
 Lgt = Light/Lighting
 Lkr = Locker Room
 Lvl = Level
 N = North
 Occ = Occupancy
 Off = Office
 Out = Output
 Ovrd = Override
 Pos = Position
 Pkg = Parking
 Rly = Relay
 Rm = Room
 S = South
 Sgn = Signage
 Shd = Shade
 Snsr = Sensor
 Spt = Spot lights
 Stg = Seating
 Sts = Status
 W = West
 Wdw = Window
 Wrk = Work
 Zn = Zone

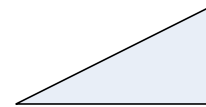
EL.EPLA_EnrgTot (kWh)
 EL.EPLA_Pwr (kW)



Rm301_OccSnsrEna (Off/On)
 Rm301_OccSnsr (Off/On)
 Rm301_DayLgtLvl (W/sqft, fc, lumens)
 Rm301_LgtOvrd (Off/Ovrd)
 Rm301_LgtOvrdTm (min)
 Rm301_IntLgtLvl (W/sqft, fc, lumens)
 Rm301_WrkLgtLvl (W/sqft, fc, lumens)
 Rm301_LgtLck (Off/On)
 Rm301_Shdcmd (Off/On, %)
 Rm301_Shdsts (Off/On)
 Rm301_Shdspos (%)



Rm301_LgtEna (Off/On)
 Rm301_LgtSts (Off/On)
 Rm301_LgtCmd (Off/On)
 Rm301_LgtRlySts (Off/On)
 Rm301_LgtRlyCmd (Off/On)
 Rm301_LgtGrpSts (Off/On)
 Rm301_LgtGrpCmd (Off/On)



Rm301_LgtOutCmd (%)
 Rm301_LgtOutPos (%)

PROJECT

BAS Object Naming Standard

Equipment Schematics

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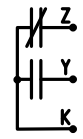
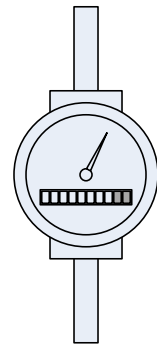
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LGT

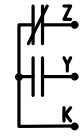
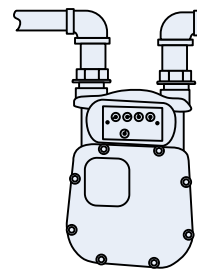
See ELEC page for electrical metering objects.

Water Meters



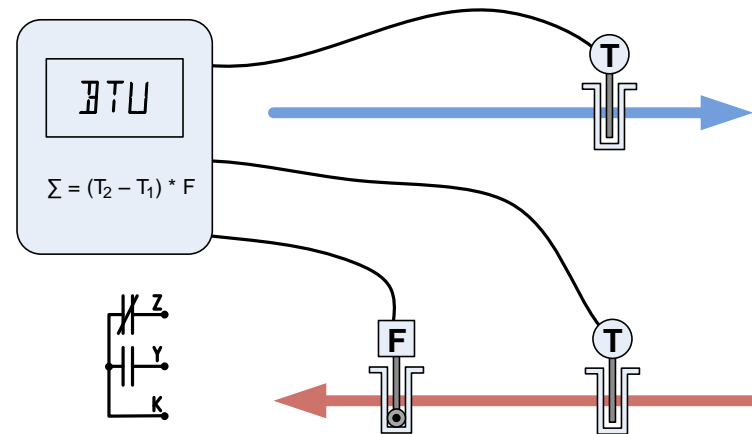
- DW.Main_PlsTot (pulses)
- DW.Main_PlsTotRst (Off/On)
- DW.Main_PlsGain (coeff)
- DW.Main_VolTot (gal)
- DW.Main_FlwRat (gpm)
- DW.Main_FlwRatMax (gpm)
- DW.Main_VolTotNet (gal)

Gas Meters



- NG.Main_PlsTot (pulses)
- NG.Main_PlsTotRst (Off/On)
- NG.Main_PlsGain (coeff)
- NG.Main_VolTot (cf, ccf)
- NG.Main_FlwRat (cfm)
- NG.Main_FlwRatMax (cfm)
- NG.Main_VolTotNet (cf, ccf)
- NG.Main_EngTot (btu, kbtu, mbtu, therms, kW, MW)
- NG.Main_EngContent (btu/cf)

Thermal Energy Meters



- TE.CHW_FlwRat (gpm)
- TE.CHW_FlwRatMax (gpm)
- TE.CHW_CHWSTmp (°F)
- TE.CHW_CHWRTmp (°F)
- TE.CHW_DifTmp (°F)
- TE.CHW_DifTmpMax (°F)
- TE.CHW_EngFlwRat (btu/hr, kbtu/hr)
- TE.CHW_EngTot (btu, kbtu, mbtu, kW)
- TE.CHW_EngRatMax (btu/hr, kbtu/hr)
- TE.CHW_EngTotRst (Off/On)
- TE.CHW_PlsTot (pulses)
- TE.CHW_PlsTotRst (Off/On)
- TE.CHW_PlsGain (coeff)

Standard Metering Object Name Format: BBBBTTTtr.DDDD_NNNNNNNNNNN

Where:

- BBBBBB = Six-character Building Number or Abbreviation
- TT = Two-character Standard Meter Type Abbreviations
- . = Standard Meter Delimiter
- DDDDDDDD = Eight-character Meter Designation (variable)
- NNNNNNNNNNNN = Twelve-character Standard Object Name

Standard Meter Type Abbreviations

- CH = Chilled Water
- CW = Condenser Water
- DF = Diesel Fuel
- DH = Domestic Hot Water
- DW = Domestic Water
- FO = Fuel Oil
- GW = Gray (Reclaimed) Water
- HW = Heating Hot Water
- IW = Irrigation Water
- MW = Make-up Water
- NG = Natural Gas
- PG = Propane Gas
- SH = Solar (Heat) Thermal Energy
- ST = Steam
- TE = Thermal Energy
- TW = Tempered Water

PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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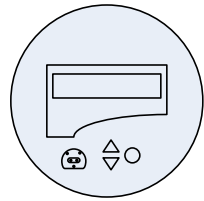
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MTR

Common Electric Smart Meter Objects



Basic Meter

- EL.[circuit]_VltAC (VAC)
- EL.[circuit]_Cur (Amps)
- EL.[circuit]_Pwr (kW)
- EL.[circuit]_Enrg (kWh)

DC Systems

- EL.[circuit]_VltDC (VDC)
- EL.[circuit]_Cur (Amps)
- EL.[circuit]_Pwr (kW)
- EL.[circuit]_Enrg (kWh)

- EL.[circuit]_VltAB (VAC)
- EL.[circuit]_VltBC (VAC)
- EL.[circuit]_VltCA (VAC)
- EL.[circuit]_VltLLAvg (VAC)
- EL.[circuit]_VltLLMin (VAC)
- EL.[circuit]_VltLLMax (VAC)
- EL.[circuit]_VltLLMean (VAC)
- EL.[circuit]_VltAN (VAC)
- EL.[circuit]_VltBN (VAC)
- EL.[circuit]_VltCN (VAC)
- EL.[circuit]_VltLNAvg (VAC)
- EL.[circuit]_VltLNMin (VAC)
- EL.[circuit]_VltLNMax (VAC)
- EL.[circuit]_VltLNMean (VAC)
- EL.[circuit]_CurA (Amps)
- EL.[circuit]_CurB (Amps)
- EL.[circuit]_CurC (Amps)
- EL.[circuit]_CurAvg (Amps)
- EL.[circuit]_CurMin (Amps)
- EL.[circuit]_CurMax (Amps)
- EL.[circuit]_CurMean (Amps)
- EL.[circuit]_Freq (Hz)

- EL.[circuit]_RelPwrA (kW)
- EL.[circuit]_RelPwrB (kW)
- EL.[circuit]_RelPwrC (kW)
- EL.[circuit]_RelPwrTotal (kW)
- EL.[circuit]_RelPwrMax (kW)
- EL.[circuit]_EnrgRec (kWh) (imported from grid)
- EL.[circuit]_EnrgDel (kWh) (exported to grid)
- EL.[circuit]_EnrgRecNet (kWh)
- EL.[circuit]_EnrgDelNet (kWh)
- EL.[circuit]_AppPwrA (kVA)
- EL.[circuit]_AppPwrB (kVA)
- EL.[circuit]_AppPwrC (kVA)
- EL.[circuit]_AppPwrTotal (kVA)
- EL.[circuit]_AppPwrMax (kVA)
- EL.[circuit]_AppEnrgRec (kVAh)
- EL.[circuit]_AppEnrgDel (kVAh)
- EL.[circuit]_RctPwrA (kVAR)
- EL.[circuit]_RctPwrB (kVAR)
- EL.[circuit]_RctPwrC (kVAR)
- EL.[circuit]_RctPwrTotal (kVAR)
- EL.[circuit]_RctPwrMax (kVAR)
- EL.[circuit]_RctEnrgRec (kVARh)
- EL.[circuit]_RctEnrgDel (kVARh)

- EL.[circuit]_PwrFctrA (%)
- EL.[circuit]_PwrFctrB (%)
- EL.[circuit]_PwrFctrC (%)
- EL.[circuit]_PwrFctrAvg (%)
- EL.[circuit]_VltUnbal
- EL.[circuit]_CurUnbal
- EL.[circuit]_PhsRev (False/True)
- EL.[circuit]_VltPhsSeq
- EL.[circuit]_PlsOut1 (Off/On)
- EL.[circuit]_PlsOut2 (Off/On)
- EL.[circuit]_PlsOut3 (Off/On)
- EL.[circuit]_PlsOut4 (Off/On)
- EL.[circuit]_PlsIn1 (Off/On)
- EL.[circuit]_PlsIn2 (Off/On)
- EL.[circuit]_PlsIn3 (Off/On)
- EL.[circuit]_PlsIn4 (Off/On)
- EL.[circuit]_PlsTot1 (pulses)
- EL.[circuit]_PlsTot2 (pulses)
- EL.[circuit]_PlsTot3 (pulses)
- EL.[circuit]_PlsTot4 (pulses)

- EL.[circuit]_THDvItA (THD)
- EL.[circuit]_THDvItB (THD)
- EL.[circuit]_THDvItC (THD)
- EL.[circuit]_THDCurA (THD)
- EL.[circuit]_THDCurB (THD)
- EL.[circuit]_THDCurC (THD)
- EL.[circuit]_KfctrCurA (coeff)
- EL.[circuit]_KfctrCurB (coeff)
- EL.[circuit]_KfctrCurC (coeff)
- EL.[circuit]_CfctrCurA (coeff)
- EL.[circuit]_CfctrCurB (coeff)
- EL.[circuit]_CfctrCurC (coeff)
- EL.[circuit]_CtRatio (Ratio)
- EL.[circuit]_PtRatio (Ratio)
- EL.[circuit]_Serial (SN)
- EL.[circuit]_RO1 (Off/On)
- EL.[circuit]_RO2 (Off/On)
- EL.[circuit]_RO3 (Off/On)
- EL.[circuit]_RO4 (Off/On)

Standard Metering Object Name Format: BBBBTT.DDDD.NNNNNNNNNNN

Where:
 BBBB = Six-character Building Number or Abbreviation
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 DDDDD = Eight-character Meter Designation (variable)
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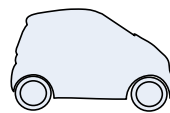
Standard Electric Meter Type Abbreviations

EL = Electricity
 PV = Photovoltaic Electricity
 WD = Wind Electricity

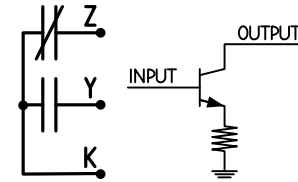
Common Generator Objects

- PwrCap (kW)
- PwrPct (%)
- BattVlt (VDC)
- OilPrs (PSI)
- OilTmp (°F)
- CoolantTmp (°F)
- FuelRat (gal/hr)
- EngSpd (rpm)
- EngStarts (starts)
- EngRntm (hours)
- EngStartCmd (Off/On)
- RstCmd (Off/On)
- FltCode (varies)
- WamCode (varies)
- FuelRem (gal)
- RntmRem (hours)
- ExhLvrCmd (Off/On)
- ExhLvrSts (Off/On)
- GenTest (Off/On)
- AtsSts (Off/On)
- GenAlm (Off/On)

Common EV Charging Station Objects



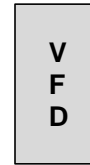
- CurLmt (Amps)
- StationMode (varies)
- StationSts (varies)
- StationEna (Off/On)
- EnrgDel (kWh)
- EnrgRec (kWh)
- ChargeCur (Amps)
- PwrPct (%)
- PwrCap (kW)
- PwrLmt (kW)
- EVID (SN)



KYZ & Open Collector Pulses

- EL.[circuit]_PlsTot (pulses)
- EL.[circuit]_PlsTotRst (Off/On)
- EL.[circuit]_PlsGain (coeff)

Common VFD Objects



- [prefix]Cmd (Off/On)
- [prefix]Sts (Off/On)
- [prefix]Spd (%)
- [prefix]Fdbk (%)
- [prefix]Alm (Off/On)
- [prefix]Pwr (kW)
- [prefix]Enrg (kWh)
- [prefix]RnTm (hours)
- [prefix]Cur (Amps)
- [prefix]VltAC (VAC)
- [prefix]VltDC (VDC)
- [prefix]AutoMode (Hand/Off/Auto)
- VFD##_EL.Pwr (kW)
- VFD##_EL.Enrg (kWh)
- VFD##_EL.Cur (Amps)
- VFD##_EL.VltAC (VAC)
- VFD##_EL.VltDC (VDC)

Common Photovoltaic System Objects

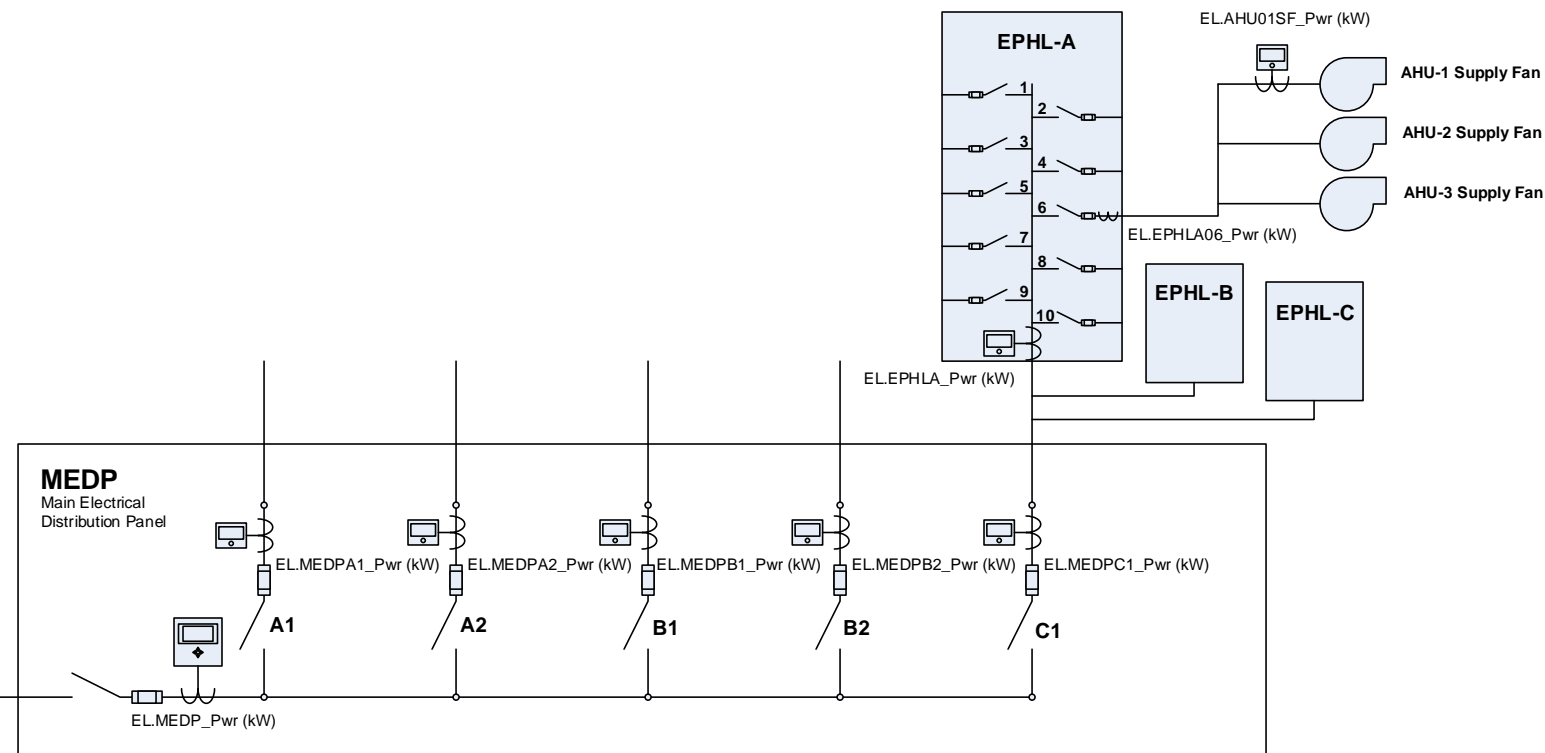
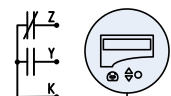
PV System Points

- EL.INV1_ModuleTmp (°F)
- EL.INV1_IrradPOA (W/m^2)
- EL.INV1_IrradGlbHor (W/m^2)
- EL.INV1_GndFlt (Off/On)
- EL.INV1_Perf (%)
- EL.INV1_ModuleTmpCoeff (coeff)
- EL.INV1_InvPwrMax (kW)
- EL.INV1_InvPwrMax (kW)
- EL.INV1_Comb###Cur (Amps)
- EL.INV1_Comb###Vlt (VDC)
- EL.INV1_Comb###Enrg (kWh)
- EL.INV1_InvSts (varies)
- EL.INV1_InvMode (varies)
- EL.INV1_DCLnkVlt (VDC)
- EL.INV1_DCBusVlt (VDC)

- EL.Array1_ArrayPwrMax (kW)
- EL.Array1_IrradPOA (W/m^2)
- EL.Array1_IrradGlbHor (W/m^2)
- EL.Array1_Perf (%)
- EL.Array1_ModuleTmpCoeff (coeff)



- EL.Util_PlsTot (pulses)
- EL.Main_Enrg (kWh)



PROJECT

BAS Object Naming Standard

Equipment Schematics

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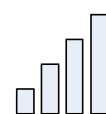
ELEC



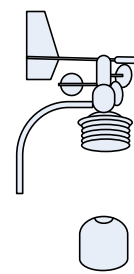
Generic Device Points

- DevSts (Off/On)
- DevAlm (Off/On)
- Serial (sn)
- BootCount (boots)
- ErrorCode (varies)
- Uptime (sec, min, hours)
- PcbTmp (°F)
- DevFlt (Off/On)
- PrevFltCode (varies)
- ActiveFltCode (varies)
- FltCount (faults)
- RstCmd (Off/On)
- RebootCmd (Off/On)
- UTC (UTC)

Wireless Device Points



- Signal (%)
- NodesTot (nodes)
- NodesOnline (nodes)
- RadioGrp (group)
- RadioAdd (address)
- RadioSts (Off/On)
- NodeSts (Off/On)
- BattSts (Off/On)
- BattAlm (Off/On)
- BattRem (%)



Weather Points

- Wthr_OATmp (°F)
- Wthr_OATmpMax (°F)
- Wthr_OATmpMin (°F)
- Wthr_OATmpAvg (°F)
- Wthr_OARElHum (%)
- Wthr_OADew (°F)
- Wthr_OAPrs (inHg)
- Wthr_OAEnth (btu-lb)
- Wthr_WindChill (°F)
- Wthr_HtlIndex (°F)
- Wthr_PrecipGauge (in)
- Wthr_PrecipSts (Off/On)
- Wthr_WindSpd (mph, fps)
- Wthr_WindDir (deg)
- Wthr_WindSpdMax (mph, fps)
- Wthr_IrradGlbHor (W/m^2)
- Wthr_IrradDirNorm (W/m^2)

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STATUS: Version 1.0

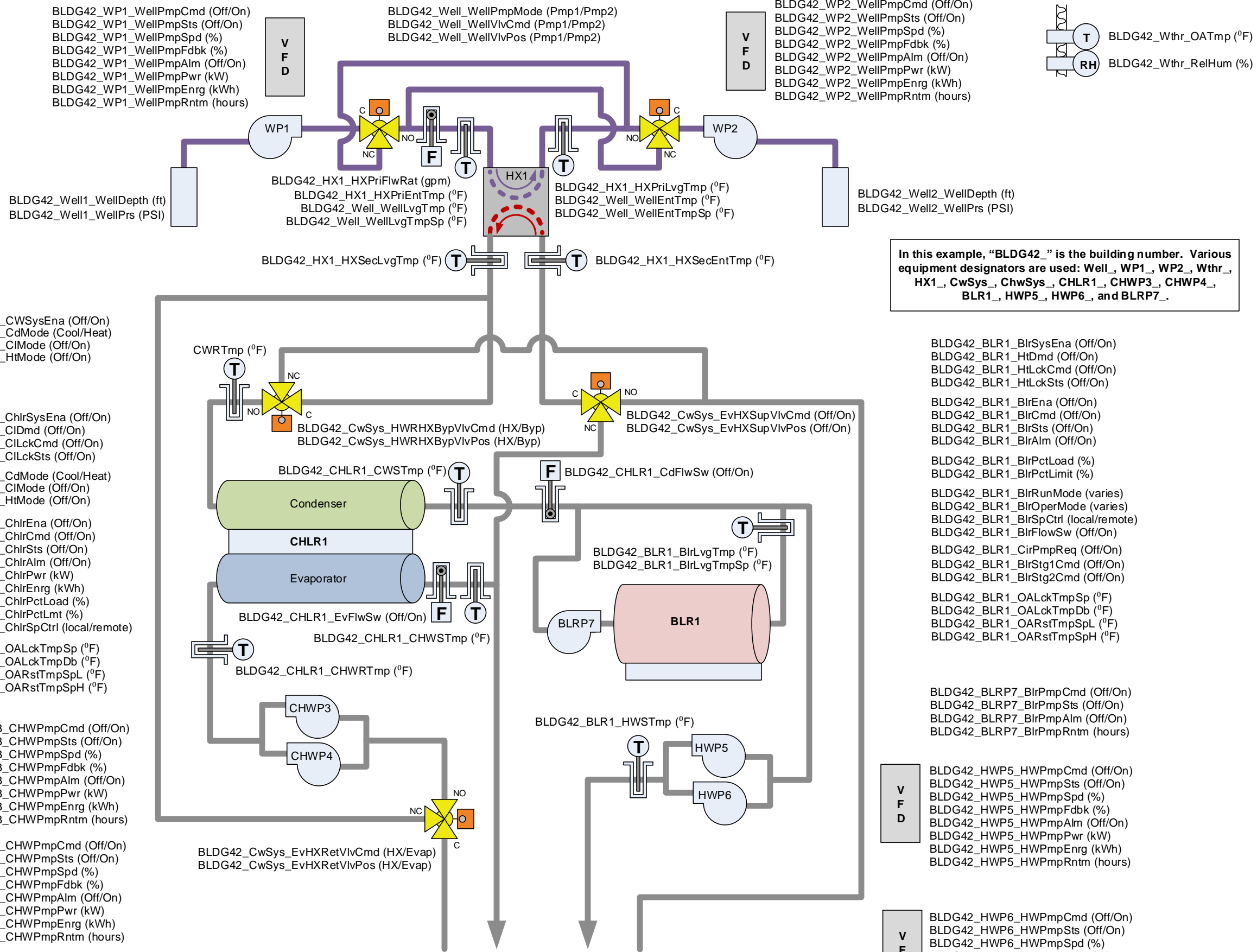
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MISC



PROJECT

BAS Object Naming Standard

Equipment Schematics

#	DATE	DESCRIPTION
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EXAMPLE

Standards

DIVISION 02 – GENERAL REQUIREMENTS

Section 02 01 50 – Maintenance of Site Remediation

Introduction

- This section contains standards for protection of in-place and trimming of existing trees that interfere with, or are affected by, execution of the work, whether temporary or permanent construction.

Part 1 - General

- Tree Protection Zone: The area surrounding individual trees or groups of trees that are to remain during construction, defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

Part 2 - Products

- Chain-link fence panels for temporary fencing.
- Coarse bark mulch to cover area under protected trees.
- Plant material used to replace damaged plant materials shall be new plant material.

Part 3 - Execution

- Preparation
 - Locate and flag with surveyor's tape trees and vegetation that are to remain or to be removed.
 - Engage Owner's Certified Arborist to direct pruning of trees to remain on site.
 - Install temporary fencing around tree protection zones to protect remaining trees and vegetation from construction damage. Locate fencing as shown on plans. Maintain temporary fence and remove when construction is complete.
 - Mulch tree protection areas with organic matter to a depth of 3 inches.
 - Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
 - Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems. Locate portable restrooms outside tree protection zones.
 - Maintain tree protection zones free of weeds and trash.
 - Arrange with Owner for regular irrigation of protected trees.
- Excavation
 - Install shoring or other protective support systems outside the tree protection zone to minimize sloping or benching of excavations onto the tree root zone.
 - Outside the Tree Protection Zone:
 - Shovel is to be pulled away from the edge of tree protection zone. If roots larger than 1 inch in diameter are encountered outside the tree protection zone, the Owner's Certified Arborist shall be consulted prior to pruning these roots.
 - Roots encountered during excavation will be redirected into the backfill areas where possible. If large, main lateral roots are encountered, the excavation limits will be extended as necessary to expose roots to a length as required to bend and

redirect them into the backfill without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots cleanly 3 inches back from new construction.

- If tree roots larger than 1 inch in diameter require pruning due to construction activities, the Owner's Certified Arborist shall be consulted prior to pruning.
 - Roots exposed during excavation will be protected to prevent drying until permanent backfill is placed.
 - Exposed roots will be temporarily supported and protected from compaction and damage until they are permanently relocated and covered with soil.
- Within the Tree Protection Zone
 - Where excavation for new construction is required within tree protection zones, do not proceed without the Owner's written approval. Hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
 - If tree roots larger than 1 inch in diameter require pruning due to construction activities, the Owner's Certified Arborist shall be consulted prior to pruning.
- Utility Trenches
 - Where utility trenches are required within tree protection zones, do not proceed without the Owner's written approval. Tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand. Use existing utility locations where possible.
 - Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop. Do not apply any material to cut faces of roots.
 - If tree roots larger than 1 inch in diameter require pruning due to construction activities, the Owner's Certified Arborist shall be consulted prior to pruning.
- Regrading
 - Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single un-compacted layer and hand grade to required finish elevations. Do not grade so that tree trunk is in low spot after finish grading.
 - Change of grade beyond 6 inches: Where existing grade at tree protection zone differs by more than 6 inches from finish grade, construct retaining walls to keep original grade under tree.
- Hardscape around trees
 - In parking lots, allocate 8 foot x 8 foot uncovered space for trees preserved on site. Asphalt cover: Irrigate tree protection zone well the night before. Slope asphalt slightly into planting pit. Flood irrigate again after asphalt installation.
 - Concrete and impermeable paving: Flood irrigate tree protection zone the night before pouring. Protect tree zone from traffic, trash, or backwash during concrete pour. Irrigate tree again the following day.
 - Structural Soil, Structural Cells, and alternative media: Flood irrigate tree zone well the night before. Protect tree zone from backwash or trash during installation of aggregate. Irrigate again the next day.
- Tree repair and replacement
 - Notify the Owner immediately if trees and shrubs to remain in place are damaged during

- construction. Do not repair damage except with the Owner's Arborist written direction.
- Promptly repair trees damaged by construction operations within 24 hours of damage. Treat damaged trunks, limbs, and roots according to Owner's Arborist's written instructions.
 - Trees indicated to remain on the site which die or are damaged during construction that Owner's Staff Arborist has determined are incapable of restoring to normal growth pattern will be removed and replaced during construction operations.
 - Provide new trees of same size and species as those being replaced; plant and maintain these trees.
 - Any and all costs of repair or replacement will be assessed to the contractor.

End of Section 02 01 50

DIVISION 02 – EXISTING CONDITIONS

Section 02 41 00 - Demolition

Introduction

This section shall be used by the consultant to accurately define the scope of the demolition effort required for the project. Whenever possible a demolition plan shall be created to graphically show the extent of the demolition work.

The scope of the demolition plan should be carefully reviewed and coordinated with **Risk Management** to ascertain the existence of any hazardous materials requiring special attention. Most laboratory equipment will require decontamination before demolition and/or removal, i.e., fume hoods, laminar flow enclosures, clean benches, biological safety cabinets, etc.

Provisions shall be made in the documents to require that all demolition work be performed without disruption to adjacent occupied areas, i.e., off hours work. Only when the anticipated demolition work will not present a disruption to the user or occupant can the assumption be made that it can be conducted at any time.

Demolition work is usually associated with trash and dust. Appropriate provisions shall therefore be made to address mitigation procedures in the demolition work.

The demolition plan shall identify all materials/equipment, etc., which are to be reused and/or salvaged by either the College or the Contractor. Please keep in mind that all equipment and building material is ultimately the property of the College and only when its salvage cost exceeds its usable value is it to be considered unwanted. This determination can only be made by the College.

A complete investigation of the area(s) shall be performed so that all existing aspects and elements affected by the project are either removed under the demolition plan or incorporated into the new work with the installation drawings, i.e., existing/abandoned outlets, t-stats etc.

Part 1 – General

- Other than items that are to be reused, there are basically two groups of salvageable material presented with nearly all projects. Care must be exercised when handling all salvageable material to maintain its value.
- Items that are **always** salvaged by the College:

LED exit lights	Door hardware	Fire alarm devices
Chalk/White boards	Drinking fountains	Simplex equipment
EMCS equipment	Window blinds	Lab fixtures
Meters (all kinds)	Backflow preventers	Side Lights for SC Wood Doors

- Items that the College may elect to salvage. Depending on the item, the College will determine on a case by case basis whether salvage is warranted. The following is a representative, but not conclusive, list of items in which salvage may be considered.

Wood/HM doors	Plumbing fixtures	Electrical light fixtures
Electrical panels	Casework	Electrical equipment
Mechanical equipment	Disconnect switches	Starters
Ceiling diffusers	Elevator equipment	Windows
Projection screens	Soap/Paper dispensers	Transformers
Mirrors	Clocks	Thermostats
Irrigation equipment	Access doors	Shelving

Refrigeration equipment	Landscape plantings	HVAC mixing boxes
Lab equipment (hoods)		

- Prior to finalizing the construction documents the Architect shall conduct a site meeting with the appropriate Facilities Management personnel and determine precisely what items are to be salvaged. The documents should then clearly identify what is to be salvaged, by whom and where it is to be delivered to or stored. Options include but are not limited to:
 - Removal and transport by contractor.
 - Removal by contractor and transport by PCC.
 - Removal and transport by PCC.
 - Transportation destinations include the Facilities Warehouse located at the Maintenance & Security Building.
- Whenever PCC is to participate in either the removal or transportation of salvage materials a period and contact person shall be identified and referenced in the documents.
- All items encountered which contain an affixed College Inventory Control tag ("A" tag) require special procedures for dispersal. Consequently, these items should be brought to the attention of the PCC Project Manager. Items that contain an "A" tag are part of the registered inventory of a particular PCC department or unit and dispersal must be coordinated through their respective business manager.
- Fluorescent light fixture tubes and certain light fixture ballasts must be separately disposed of in accordance with applicable environmental regulations. Consequently, the removal and disposal of existing fluorescent light fixtures shall include the following:
 - All fluorescent tubes shall be removed and packaged by the Contractor in cartons supplied by the Facilities Electric Shop. The number of tubes in each carton shall be clearly marked on the outside of the carton. Contractor to deliver packaged tubes to the Facilities Electric Shop for disposal.
 - Fixture ballasts not clearly marked as containing "No PCB's" shall be removed by the Contractor and after short clipping all wires place them in a metal drum supplied to the jobsite by Pima Community College Risk Management. After completion of the demolition effort, Pima Community College Risk Management will remove the drum for disposal offsite. Apportioned disposal costs are then to be charged to the project.

Part 2 - Products

- No discussion.

Part 3 - Execution

- All electrical services discontinued with the demolition effort shall be properly "tagged out".
- Because all facilities within the College campuses are classified as NESHAP facilities, the regulatory requirements of the Pima County Department of Environmental Quality apply to all demolition projects. Consult with Risk Management to determine the exact requirements. All permits and fees for demolition are the responsibility of the contractor but these requirements should be specifically identified in the contract documents.

End of Section 02 41 00

DIVISION 02 – SITEWORK

Section 02 42 21.91 – Yard Waste Salvage

Introduction

This section contains standards for the identification, removal, storage and replanting of existing trees on site. Pima Community College shall maintain all existing palm trees, however palm trees are not to be replaced and/or used in exterior improvements.

Part 1 - General

- Create a Reference Sheet for identification of trees to be salvaged.
- Provide backflow prevention devices for the temporary irrigation system.
 - Holding Yard: The holding yard for this project will be on or adjacent to the project site with an available water source. Water shall be provided by the Contractor.
- Identification of salvage material
 - The Contractor, Architect and Owner's representatives will determine the final selection of salvage specimens based on specimens already identified, current health, accessibility, viability and appearance.
 - These trees shall be final-tagged with colored tape in conspicuous locations and fenced with temporary construction fence and irrigated to avoid construction damage until they are removed.
 - Contractor is not to remove or work on any salvage material until after the Owner, or designated agent, has determined the limits of the salvage and work area, and has given the Contractor written consent to proceed.
- Removal of salvage material
 - Description of Work: The Contractor shall provide all labor, tools and materials necessary to remove salvage plants from the ground, box them (when required) and transport them to the holding yard.
 - If it is determined that any of the trees to be transplanted can be immediately installed in their new location within the project, the Contractor may do so, but must water, maintain and protect the trees during construction.
 - If any trees are to be transplanted directly onto PCC property, the final site will need to be Blue Staked. Allow time for approval.
 - Access: Access shall be entirely within the Owner's property. Damage to surrounding areas not within the property, including but not limited to buildings, curbs, paving, vegetation and utilities, shall be the Contractor's responsibility.
 - The Architect will also identify areas within the property that are not to be disturbed. Any damage within these areas will also be the Contractor's responsibility. If designation of these areas makes access impossible, Contractor shall notify the Architect.
- Protection
 - Contractor shall provide barrier protection to warn pedestrians about the plant excavations, and reasonably prevent someone from falling into one. Protection shall be selected by the Contractor and suitable for the purpose intended and approved by the Architect and Owner.
 - Protection shall be provided during sidebox operations and following removal of the boxed tree, and shall remain in place until the excavation is filled under grading operations.

- Warranty
 - The Contractor shall warranty plants from damage caused by his own operations including boxing, holding and replanting. This warranty includes breakage of major limbs (after trimming), destruction of major root systems, excessive scarring to the trunk, and death from stress or severe insect damage.
 - The Value of the trees to be salvaged shall be determined by a qualified Arborist, and shall be based in whole or in part on the following factors:
 - 1) Suitability of the species for the site
 - 2) Tree health and vigor prior to start of construction
 - 3) Replacement cost for a comparable tree at a local supplier
 - 4) Increase in value of the PCC tree based on increase in size beyond that of saleable size
 - 5) Rarity within the PCC campus tree collection 6) dollar contribution of tree as modeled in USFS i-Tree Suite of software programs
 - Should replacement material be required under this warranty, Contractor is responsible for the procurement and transportation of the replacement material.
 - Plant materials shall be guaranteed for one year following final acceptance of planting operations under this section.

Part 2 - Products

- Box Materials
 - Boxes shall be of wood strong enough to allow transport of trees both to and from the storage facility.
 - Boxes shall be of wood, resistant to rot and fungus, and capable of lasting at least three years.
 - Should the box require replacement, or damage occur to the tree as a result of poor box material, the tree shall be replaced as a warranty item at no additional cost to the Owner.
- Nutrients
 - Contractor shall apply chemical nutrients to the tree, as needed, to maintain tree in good health. Balanced fertilizer at ½ strength and Vitamin B-1 shall be used per manufacturer's recommendations with the first watering.
 - Loss of tree from lack of nutrients or over-fertilizing shall be considered a warranty item and the tree shall be replaced at no additional cost to the Owner.
 - Contractor should use an anti-transpiration agent such as Vapor Guard, or approved equal, as needed to prevent excessive wilting and wind damage.

Part 3 - Execution

- Trimming and Pruning
 - The Contractor shall prune off all dead limbs from the salvage material.
 - Contractor consult with the Owner's Certified Arborist before removing canopy branching from the tree only, as needed, to reduce stress on tree during the moving operation.
 - Pruning cuts shall be clean and outside the branch collar. Techniques shall follow current ANSI 300 Standards for Pruning. Pruning shall be done in such a manner as to retain the original character and structure of the trees.
 - Any tree which is found to be diseased at this stage may be removed from the salvage list with the approval of the Architect.
 - Contractor is responsible for protection of cuts after pruning. No pruning paint shall be applied to wounds.
 - Architect and Owner's Arborist shall inspect tree pruning prior to side boxing. Trees that, in their opinions, are of unacceptable shape, size or canopy may be removed from the salvage list at this time.

- **Boxing**
 - Contractor shall identify the size (caliper) of the tree and the corresponding box size. The chart below gives the approximate relationship between box size and caliper size. Contractor may, at his discretion, increase the box size, but should not decrease the box sizes from those listed below. Caliper sizes indicated on the tree inventory plan may vary some from actual conditions. Contractor is responsible for determining actual caliper size for each tree identified for salvage.

Trunk Diameter in Inches	Box Size in Inches
Under 4"	42"
7-1/2"	45"
8-1/2"	48"
10"	51"
13"	54"
14"	57"
Over 14"	60 – 120"

- The Contractor shall side box the trees a minimum of 35 days prior to removing the trees.
- During the side boxed holding period, the Contractor shall provide water, nutrients and herbicides to the salvaged material, as needed. Failure to provide proper care during this stage, which results in the loss of the material, shall be treated as a warranty item.
- Removal: As the tree is removed from the ground, the Contractor shall provide reasonable care during this operation to avoid breaking of limbs and scarring of the trunk.
- Transportation:
 - The Contractor shall transport the trees from their location in the field to the designated holding yard.
 - This transportation includes the loading and unloading of the trees from the truck or other transporting vehicle.
- Maintenance of plants during holding period
 - The Contractor shall provide all labor, tools and materials necessary for the maintenance of the salvage materials in the holding yard during a holding period as previously specified.
 - The Contractor shall be responsible for the replacement of salvage material which dies or is seriously damaged during the holding period. See the warranty section for complete specifics of this warranty.
 - Holding Yard:
 - The Contractor shall store or make arrangements for the storage of all salvaged material in the secure yard during construction. This yard shall be located as designated by the Architect and Owner's Representative.
 - The holding yard shall be open for prearranged inspections on a regular basis by the Architect and Owner's Representative.
 - All salvage material shall be clearly labeled and stored in one specific location if other plant material is stored onsite.
 - Time Limitation: The Contractor shall be responsible for maintenance of the material as previously after delivery of the material to the holding yard.
 - Water: The Contractor shall be responsible for provision of a temporary drip irrigation system sufficient to provide water to the salvage material. Contractor shall be responsible for making new connection and removing temporary lines at end of holding period.
 - Fertilizer: The Contractor shall be responsible for provision of nutrients needed to maintain the material in a healthy condition.
 - Other: The Contractor shall be responsible for the provision of any other materials necessary for the maintenance of the salvage material in a healthy condition and secure location.

- The Contractor shall provide qualified manpower on a regular basis to inspect the trees for health and vigor.
- The Contractor shall participate with the Architect and Owner's Representative on a monthly basis for inspection.

- Monthly operations
 - The planting of the salvaged material will be done in the same general area as the salvage operations. Exact location will be per the landscape plans.
 - Plant hole sizes and planting mixtures will be as shown on the plans.
 - Contractor shall coordinate planting and new irrigation with the general landscape contractor. The general landscape contractor will install the permanent irrigation system. The irrigation system must be functional within a week of tree installation.

- Cleanup
 - Contractor shall maintain the area of his work free from debris and extraneous material throughout the course of this work.

End of Section 02 42 21.91

DIVISION 03 - CONCRETE

Section 03 31 00 - Structural Concrete

Introduction

Drawings shall be coordinated between the various other sub-consultants to avoid field problems with openings, shear walls and structural slabs. Drawings shall show special reinforcement required at openings. Drawings shall show location of construction, expansion and contraction joints.

Part 1 - General

- ACI references shall be comprehensive to cover the requirements needed.
- For special or critically flat floor slabs- use FF & FL numbering system set forth in ACI117 & ASTM E1155 for floor flatness/levelness.
- Concrete testing
 - Less than 50 cubic yards - by Contractor
 - Greater than 50 cubic yards - by Pima Community College with a retesting charge for concrete not meeting specification.
- Mock-up should be provided for any structural concrete that is to receive a finish treatment such as a sandblasted, exposed aggregate or bush hammered finish. Any special finish treatment should be specified in Section 03 33 00 - Architectural Concrete. Mock-up shall not be incorporated into the final work.

Part 2 - Products

- Form materials. Metal or wood should be specified.
 - Wood forms: Specify grade and thickness of plywood form material. Limit reuse to 3 times Exposed concrete - Use HDO plyform.
 - Unexposed concrete - Use AC plywood.
 - Column forms: Specify metal, fiberglass or sonotube (lined or unlined). These types are not equal. Seam placement should be considered to insure workmanship-like patch if in finished area.
 - Pan forms: Specify specific type (steel, glass-fiber or reinforced plastic). These types are not equal and provide different finishes. Although discouraged, if underside is to be left exposed, pans are to be in "like new" condition.
 - Fiberglas grip form ties shall not be allowed.
- Rebar - if required to be welded, the appropriate type should be specified.
- To alleviate flooring material concerns associated with moisture transmission and emission through concrete slabs on grade the following preventive measures shall be prescribed.
 - A minimum 10 mil under slab vapor barrier shall be specified and detailed directly under the concrete slab and on top of any subgrade or sand grading material to minimize moisture transmission through the slab. Vapor barriers shall meet the requirements ASTM E-1745 Class "C".
 - A low water to cement ratio, low slump concrete should be specified for all interior slabs where flooring is anticipated to minimize the amount of free water in the concrete. Sufficient time should be allowed with the project to allow the emission of any free moisture to evaporate from the slab.
 - Surface sealers may be considered for re-flooring applications on existing slabs.

- Curing compounds and form release agents shall be non-staining and be compatible with the wall and floor finishes specified. Once selected for a project, they shall be used for the entire project.
- Sealers on exposed interior concrete floors shall be compatible with Johnson Wax Carefree and High Mileage. Refer to Section 09 00 00 – General Discussion for additional discussion and considerations.
 - Penetrating sealers (silicon, epoxy, etc.) shall not be used when a custodial effort is intended to maintain the finish of the floor.
 - Sealer or finish should be applied immediately after the dissipation of the curing compound in order to protect floors during construction and then cleaned and reapplied prior to final acceptance.
- Minimum concrete compressive strength shall be 3000 psi for interior slabs on grade. Exterior sidewalks and slabs can utilize 2500-psi concrete. Architect or engineer shall specify all concrete. Provide a detailed concrete mix schedule if more than one strength or type is required for the project.

Part 3 - Execution

- Column penetrations through slabs shall initially be blocked out in a diamond shape and infilled afterwards.
- Sandblasted or exposed aggregate finishes should be specified in Architectural Concrete. To achieve a uniform sandblast finish, special concrete mixes and forming practices are required, i.e., water tight forms.
- Slabs shall be depressed (dished) ½" deep around all floor drains.
- Provide 1-inch high dam at floor sleeves in wet walls and in wet locations above ground level.
- Provide visible post tensioned stamp in concrete at electrical and mechanical rooms located at post-tensioned concrete slabs.
- Specify concrete testing for concrete at "point of placement" per ACI Section 301-20 Execution 4.3.2 and conforming to the requirements of ASTM C 94.

End of Section 03 31 00

DIVISION 03 – CONCRETE

Section 03 33 00 - Architectural Concrete

Introduction

In general, all of the items included in Section 03 31 00 - Structural Concrete, will apply. This section shall be included when concrete will be exposed and special finishes may require non-standard formwork, special design mixes (for color or texture) and services of a specialized consultant to assist the Contractor in providing the required design results.

All of the above items should be considered if special finishes are desired. Attempts to get them without the benefit of special attention and/or an expert in this field will result in poor quality, compromised design and possibly additional charges on the part of the Contractor in connection with efforts to provide what was not specified or detailed.

Drawings must be very specific concerning the detailing for Architectural Concrete. The special features should be noted in the specifications and on the drawings. Descriptions such as “glass like”, “polished”, “light sandblast” finishes are considered as being ambiguous unless adequately specified in this section.

Part 1 – General

- Typical examples of work in this section include exposed aggregate surfaces (whether water washed or sand blasted); bush hammered, textured, colored, and specialized forming.
- Requirements for structural concrete work are not to be used for Architectural Concrete. Reference ACI Standards.
- Submittals shall be required as appropriate for color additives, aggregate, formwork details, special form ties, curing agents, retarders, form release agents and the like. These items will all effect the final appearance of the concrete.
- Mock-ups shall be required for approval before work is incorporated in the building. Size and configuration of the mock-up is important to fully evaluate all anticipated construction details. Mock-up shall not be incorporated into the final work.

Part 2 – Products

- Generally, architectural finish on concrete is associated with watertight formwork.

Part 3 – Execution

- Anticipate the fact that sandblasting is a very disruptive and messy activity that is not easily accomplished in many areas of campus. Compliance with Pima County air pollution standards will also be a requirement of the specification.

End of Section 03 33 00

DIVISION 04 – MASONRY

Section 04 20 00 - Unit Masonry

Introduction

Block and brick installations shall be reviewed and approved by PCC Facilities Planning Department.

Part 1 – General

- For all new and infill masonry work adjacent to existing walls, require that a 3' x 3' mock up wall be constructed to insure that both the brick and the cured mortar colors are satisfactorily matched. Require minimum of 3-week curing time for evaluation of the mortar color.
- On new construction a similar appropriately sized mock up should be constructed to establish the standard of acceptance for all elements of the work, i.e., mortar color, flashing, coursing, pattern, control joints, accessories, etc. To be determined by PCC Facilities Planning Department and Architectural Consultant.
- The tops of all exposed masonry walls shall receive a watertight cap, i.e., sheet metal or precast concrete, to prohibit moisture infiltration and efflorescence.
- To minimize variations, the project should be fired and supplied in one continuous run. If variations in unit masonry within the run, the differently shades shall be randomly intermixed as the wall is constructed. Obvious delineations in the unit masonry are not acceptable.

Part 2 – Products

- Selected unit masonry color shall be as available from local southern Arizona suppliers.
- The use of mortar or grout admixtures, other than color pigments, shall not be allowed. Specifically prohibit the use of any mortar retarding agents due to their unpredictable nature.
- Mortar shall be consistently batched. Use pre-mix from batch plant or use gauge boxes on-site. The use of the shovel method for measuring and batching mortar mixes should be discouraged.

Part 3 – Execution

- Tolerances: Masonry work that does not conform to the following tolerances shall be repaired or replaced as directed by the Architect. Tolerances are based on ACTUAL DIMENSIONS.
 - Variations from plumb:
 - In lines or surfaces of columns, walls, and arises: in 10 feet - $\frac{1}{4}$ " ; in any story or 20 feet maximum - $\frac{3}{8}$ " ; in four stories or more - $\frac{1}{2}$ " .
 - For external corners, control joints and other conspicuous lines: in any story or 20 feet maximum - $\frac{1}{4}$ " ; in 40 feet or more - $\frac{1}{2}$ " .
 - Variations from the level or the grades indicated on the drawings:
 - For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: in any bay or 20 feet maximum - $\frac{1}{4}$ " in 40 feet or more - $\frac{1}{2}$ " .
 - Variation of the linear building lines from established position in plan and related portion of columns, walls and partitions:

- In any bay or 20 feet maximum - $\frac{1}{2}$ " ; in 40 feet or more - $\frac{3}{4}$ "
 - Variation in cross-sectional dimensions of columns and in the thickness of walls is plus or minus $\frac{1}{4}$ ".
- The type of mortar joint should be specified. Tooled joints are preferred. Raked and flush joints are discouraged.
- Masonry anchoring
 - Anchor spacing to structural members shall be indicated, but not more than 24" o.c. vertically and 36" o.c. horizontally.
 - Anchor spacing to metal studs (single wythe masonry) shall be indicated, but not more than 16" o.c. vertically and 24" o.c. horizontally with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 1'-0" of openings and at intervals around perimeter not exceeding 8".
- Control Joints
 - Install control and expansion joints in unit masonry at 20' maximum. Joint width shall be not less than $\frac{3}{8}$ " for installation of backer rod and sealant.
- Lintels
 - Provide masonry or steel lintels where shown and/or wherever openings are more than required. Provide steel, precast or formed-in-place masonry lintels for all larger openings. Cure precast lintels before handling and installation. Temporarily support formed-in- place lintels.

End of Section 04 20 00

DIVISION 05 - METALS

Section 05 30 00 - Metal Decking

Introduction

Metal decking is a straightforward structural specification with limited College requirements.

Part 1 - General

- Specify type of attachment to structure, i.e., screws or puddle welding.
- Be aware that many metal deck manufacturers do not allow attachment of suspended loads to the underside of their metal deck. Unless engineered differently, all ceiling, framing, mechanical, plumbing and electrical supports shall be attached to the structural framing members only.
- Verify that metal deck priming or galvanizing is compatible with fireproofing when applicable.

Part 2 - Products

- There are no unique College requirements.

Part 3 - Execution

- There are no unique College requirements.

End of Section 05 30 00

DIVISION 05 - METALS

Section 05 50 00 - Metal Fabrications

Introduction

This Section applies to all miscellaneous metal items such as lintels, embeds, grating, ladders, handrails, stairs, bollards, nosing's, trim and similar architectural features.

Part 1 - General

- Metal pipe bollards shall be a minimum of 6" diameter. Where removable bollards are required, provide bollards as detailed on Drawing 32 33 00-D1 in MDSS Section 32 33 00 - Site Furnishings.

Part 2 - Products

- Metal bar grating shall be capable of withstanding a minimum uniform load of 250 psf or a concentrated load of 650 lbs.
- Grout and anchoring cement shall be non-metallic, non-shrink type.

Part 3 - Execution

- Welds shall be ground and sanded smooth for uniform painted appearance. The use of "Bondo" to fill large gaps and holes is discouraged.
- All sharp corners shall be radiused a minimum of 1/8"
- The use of expansion bolts to secure metal railing assemblies is discouraged. Anchorage should consist of direct embeds (cored holes, sleeves or plates) and/or welding.
- The use of metal pans for exterior stairs is discouraged and shall only be used with the approval of the PCC Project Coordinator. When used in an exterior application all metal pans and other associated metal stair components shall be galvanized or 100% seal weld with all metal pan surfaces epoxy painted prior to infilling with concrete to alleviate the development of rust on any hidden or confined surfaces.

End of Section 05 50 00

DIVISION 05 - Metals

Section 05 70 00 – Decorative Metal

Introduction

Destruction and degradation of architectural edges due to skateboarders, skaters and BMX bicycles is an ongoing problem at the College. Where possible, integrating deterrents into the architectural design is preferred. This can be done many different ways - with uneven edges, recesses, ground textures, railing design etc. Otherwise, specify appropriate metal skateboard deterrent systems whenever edges and surfaces create temptations. The College recognizes that not all conditions that create opportunities for skateboarders, skaters & BMX'ers can be foreseen or prevented.

Part 1 - General

- Generally, railings, concrete edges, brick edges, tile edges, concrete benches, seat walls, and protruding ledges should be evaluated for application.

Part 2 – Products

- Metal Skateboard deterrents

Part 3 – Execution

- No discussion

End of Section 05 70 00

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES

Section 06 00 00 - General Discussion

Introduction

This General Discussion Section contains material, which is important to successful millwork, wood framing and wood structural installations, in construction projects. The issues are fundamental to the basic design of the project, and the long-term success of those elements of the project, as well as the fabrication and installation process.

General Carpentry and Wood Design

Although not a material of choice for exposed conditions in our desert climate, wood is used extensively as a building material. When used in College projects and in structural conditions requiring structural design and/or calculations, Consultant shall use a professional structural engineer currently registered in Arizona. Installations shall be by contractors and tradesmen skilled in framing and carpentry work.

Architectural Woodwork / Custom Casework

Because the College anticipates a longer than average building life and higher than average use and abuse, durable, high quality architectural woodwork (millwork) is essential to the long-term success and serviceability of any project. Section 06 22 00 - Millwork specifies current Standards of the American Woodworking Institute (AWI) but modifies the standard to omit the use of certain materials in certain conditions and in certain portions of the work. Although used extensively industry wide, in the experience of the College, these materials have proven unsatisfactory and must be specifically excluded from the specifications.

Laboratory Casework

These Standards differentiate between Millwork and Laboratory Casework because of the specialized nature and use of the product. Laboratory Casework shall be specified separately in Division 12 - Furnishings. Additional standards are cited and specific pre-approved fabricators and manufacturers are listed. In addition, it may be necessary to include additional sections in Division 11 - Equipment to cover acrylic counter tops, laboratory bench tops and surfaces for acid and chemical resistance and for Laboratory Fixtures.

End of Section 06 00 00

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES

Section 06 10 00 - Rough Carpentry

Introduction

No Discussion

Part 1 - General

- Submittals shall not be required if drawings sufficiently describe products unless special attention is desired by the Consultant, or the PCC Facilities Project Manager.
- A professional structural engineer currently registered in Arizona shall seal submittals requiring structural design or calculations.
- Indicate and coordinate on plans and specifications all required solid blocking at all wall-hung fixtures, doorstops, cabinets, shelves and similar items.

Part 2 - Products

- Roof sheathing shall be a minimum of 5/8" thick, Exterior Plywood over trusses or joists at 16" or 24" spacing. At 24" spacing "ply-clips" shall be required.
- Fire Retardant Treated Lumber and plywood shall be specified and provided as required by Code and construction type.

Part 3 - Execution

- Installations shall be by contractors and tradesmen skilled in carpentry work.

End of Section 06 10 00

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES

Section 06 17 00 - Shop-Fabricated Structural Wood

Introduction

No Discussion

Part 1 - General

- Submittals shall be required for all prefabricated wood trusses including shop drawings, erection drawings, bracing and calculation.
- A professional structural engineer currently registered in Arizona shall seal submittals requiring structural design or calculations.

Part 2 - Products

- Trusses with metal webs and laminated timber top and bottom chord members are preferred, and joists, other than dimension lumber, are preferred to be the plywood web type with laminated wood top and bottom chord members. "Gang-Nail" type trusses are discouraged.
- Glue Laminated structural members shall conform to the standards of the American Institute of Timber Construction (AITC). Designer must take care to differentiate between appearance and concealed grades of structural members.

Part 3 - Execution

- Installations shall be by contractors and tradesmen skilled in carpentry work.

End of Section 06 17 00

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES

Section 06 20 00 - Finish Carpentry

Introduction

Consideration shall be given to the use of wood base, in lieu of the usual rubber base, in high use areas where equipment might impact and damage walls. Also, consider chair rails for wall protection where appropriate.

Part 1 - General

- Finish Carpentry and Interior Architectural woodwork shall be fabricated to current Standards of the American Woodworking Institute (AWI). In most circumstances, the requirements of "Finish Carpentry" may be combined with Section 06 22 00 – Millwork, rather than in a separate section.

Part 2 - Products

- All Architectural Woodwork shall be "Custom" grade (or better as may be required) according to the American Woodwork Institute (AWI) and subject to the following:
 - No particle board or particle board core plywood may be used in any part of the work.
 - Plywood shall be industrial quality.

Part 3 - Execution

- Installations shall be by skilled tradesmen or Pima Community College Trades Maintenance Crafts department. In the cases where fabricator and installer are not one and the same, product and project guarantee shall not be compromised.

End of Section 06 20 00

DIVISION 06 - WOOD AND PLASTICS

Section 06 22 00 - Millwork

Introduction

These standards differentiate between Millwork and Laboratory Casework because of the specialized nature and use of the product. Laboratory Casework shall be specified separately in Division 12 - Furnishings. The term Woodwork is used throughout this section to refer generically to both woodwork and casework.

Part 1 - General

- Reference the following standards as applicable:
 - AWS, Architectural Woodwork Standards, current edition.
 - ANSI/BHMA A156.9 – Cabinet Hardware.
 - NEMA LD3 – High Pressure Decorative Laminate.
- In most circumstances the requirements of Section 06 20 00 - Finish Carpentry may be combined with this section rather than issuing a separate section.
- Develop specifications for other related materials such as stone or quartz tops, metals, plastics, etc., that might be used in conjunction with woodwork/casework.

Part 2 - Products

- At most locations Architectural Woodwork shall be AWS “Custom” grade. Use AWS “Premium” grade at high profile locations such as reception areas, executive suites, boardrooms, museums and libraries. . Architectural Woodwork is also subject to the following additional criteria:
 - No particle board or particle board core plywood may be used in any part of the work, and shall be specifically excluded. Plywood or high grade medium density NAUF (no added urea formaldehyde) wood fiber board (MDF) may be used for cabinet doors and drawer fronts. Plywood shall be all hardwood veneer core.
 - Wood drawer and door fronts are to be finished with a 1/8” solid wood edge band.
 - Laminate drawer and door fronts to be finished with a 3 mm PVC edge band.
 - High-density NAUF (no added urea formaldehyde) wood fiber board may be considered for use in lieu of plywood for laminate tops in dry areas if approved by the Project Manager.
 - Water resistant medium density fiberboard may be considered for damp areas if approved by the Project Manager.
 - Woodwork shall be opaque or transparent finish rotary cut uniform color light birch hardwood (unless otherwise approved by the Project Manager), or plastic laminate; review with PCC Project Manager for final selection. Architect shall specify finish and call for sample submittal for review and approval.
 - Doors and drawers with plastic laminate finish shall be fully clad including inside faces of doors.
 - Minimum grades for plastic laminates shall be as follows (NEMA / Inch Thickness): For horizontal surfaces use HGS/.048 or HGL/.039, and for vertical surfaces use VGS/.028. Comply with International Standards Organization (ISO) 4586.
 - Cold rolled laminate is not permitted.
 - Thermofused high-pressure melamine or plywood are allowable for cabinet interiors. For wood, finish interior to match exterior.
 - Plastic laminate tops and back splashes are to be fabricated using 3/4” plywood unless approved otherwise. Edges and joints shall be tight, glued and sealed. Post formed tops and splashes are not

allowed. In those areas where sinks are applied to the underside of counter tops, the tops shall be fabricated from 7-ply birch plywood (3/4" minimum) with an "A" surface one side. Do not use water based laminate glues on any counter top.

- All doors shall be balanced with the same material on the backside of door as is used on the front side.
- Backer shall be provided on all counters for balance. Approved manufacturers of plastic laminate are:
 - Wilsonart
 - Formica
 - Nevamar
 - Pionite
- Approved manufacturers of Solid Surfacing Material Tops are:
 - Corian
 - Formica Solid Surfacing
 - Samsung Staron
 - Avonite
 - LG HiMac
 - Epoxy Resin Countertop (Chemtops)
- Hardware shall be indicated in a schedule in this section or in Section 08 70 00 - Hardware. If in Section 08 70 00 - Hardware, reference to that section.
 - Drawer glides shall be full extension heavy duty rated.
 - Hinges shall be concealed type full metal with manufacturer's lifetime warranty.
 - Hardware for adjustable shelves on walls shall be heavy-duty KV standard and bracket system, or equal.
- Approved hardware manufacturers are:
 - Pro Mark
 - McKinney
 - Knape and Vogt
 - Blum
 - Stanley
 - Grass America
 - Hafele
 - Salice
- Alternate woodwork products could be considered if reviewed with PCC Project Manager.

Part 3 - Execution

- Fastening devices and their attachment shall be submitted for approval prior to installation. Drywall screws will not be allowed for the attachment and installation of millwork.
- All concealed surfaces of woodwork/casework shall be treated at the shop with spray or brush application of low emitting clear finish. In the field, all concealed scribed and cut surfaces shall receive a brush application of the same material.
- Drawers shall be lock shouldered or multiple dovetailed and have applied fronts. Bodies shall be hardwood or 7-ply plywood. Bottoms shall be hardwood panel product full or stop dadoed. Exposed surfaces shall be hardwood. All drawers shall ride on full suspension drawer glides, not wood keels. As an option, drawers may be 5/8" thermofused high pressure melamine with doweled construction.

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- Shelves shall be edged plywood or solid lumber. Janitor and storage room shelving may be “Economy” grade laminate clad MDF. Particle board is not allowed.
- Indicate requirements for utility provisions, which must be coordinated by the fabricator.
- Plastic laminate application shall be specified as follows:
 - Apply side edging first, then top surface, with top surface overlapping side edging.
- Installations shall be by skilled tradesmen or Pima Community College Trades Maintenance Craft department. In the cases where fabricator and installer are not one and the same, product and project guarantee shall not be compromised.
- Follow manufacturer’s instructions for installation of solid surface, taking special care to adhere to recommendations for seams and supports.
- Large woodwork installations shall be certified using WI.
- Acclimate woodwork in climate-controlled environment prior to installation, per AWS.

End of Section 06 22 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 00 00 – General Discussion

Introduction

This general discussion section contains material which is critical to successful moisture protection systems in new construction and renovation, but which is not the sole responsibility of any individual trade. In many cases, the issues involved are fundamental to the basic design of the project, and the success or failure of the moisture protection concept is determined at the very outset of the design process.

The Consultant is expressly responsible for incorporating these overall requirements into the project, and for ensuring that all sub consultants are aware of the requirements and incorporate them into their designs as well.

Reliance on "after-the-fact" material selections to compensate for a problematic design decision is unacceptable.

Below Grade Spaces

- Below grade spaces are high-risk, expensive designs. Wherever possible, avoid:
 - The use of finished below grade spaces requiring drainage systems and wall waterproofing.
 - Planters above or adjacent to basement areas.
- Planning & Development actively discourages below grade elements in College projects. Designs incorporating below grade finished spaces will receive the strongest scrutiny during the programming and conceptual design phases. Be prepared to thoroughly document the unavoidable need for such elements.
- Subsurface moisture may work through concrete floor slabs on grade and destroying floor finishes. To ensure that this situation does not arise, provide an impermeable moisture barrier under all slabs on grade.
- Wherever below grade walls are exposed to naturally flowing groundwater or substantial landscape irrigation water, even if simply foundation walls, include a foundation drainage system in addition to damp proofing or waterproofing the walls.

Traffic Decks

- Traffic bearing decks are very difficult and expensive to successfully waterproof and maintain. Wherever possible, avoid use of finished spaces with traffic decks exposed to the weather above them.
- Planning & Development actively discourages use of such elements in College projects. Designs incorporating horizontal traffic decks will receive the strongest scrutiny during the programming and conceptual design phases. Be prepared to thoroughly document the unavoidable need for such elements. Failing such documentation, the Consultant will be directed to revise or even start completely anew the design.
- Special attention should be given to ensure that all horizontal traffic surfaces provide appropriate slip resistance.

Roof Design

- Do not design roofs which are intended to serve as walking surfaces for user functions. Activities that must be conducted on the rooftop (e.g. astronomical or weather observations, greenhouses, etc.) require a design that incorporates platforms, penthouses or similar special enclosures.

- Similarly, do not design roofs which are required to be used as working platforms for maintenance of mechanical and electrical equipment. Enclose such elements in a penthouse.
- Avoid wherever possible use of conduit and piping installed on top of the roof.
- Any mechanical or electrical equipment, which must be installed on the roof, must be installed on either a prefabricated curb or a field fabricated platform. Where the top surface of such curbs and platforms is not completely covered and waterproofed by the actual equipment, the top surface must be a solid sheet metal cap. Design must meet OSHA workspace and fall precaution criteria.
- Installation of any type of roof top mechanical or electrical equipment on sleepers is not acceptable.
- Wherever possible, make the basic roof slope, and the slope of the crickets to the drains, part of the structural system (slope the structure). When impossible or impractical to induce slope into the structure, care should be taken in the selection of tapered rooftop insulation and rigid overlayment board to insure a durable roof surface that will hold up to maintenance activities for the life of the roof and will not compress over time under various loads.
- Dead flat roofs are not acceptable.
- Design for a slope of 3/8" per foot, throughout the field of the roof and for all crickets, at the time of construction. Ensure that anticipated deflections and proposed cambers will result in a minimum slope of 1/4" per foot throughout the life of the facility.
- Space drains so that slopes in cricket valleys are at least 1/8" per foot.
- Provide metal or wood framing and sub-framing for large crickets. Cricket surfaces must be able to accept live loads similar to those of the basic roof deck.
- Small crickets up-slope of equipment curbs must maintain 1/8" per foot slope in their valleys, and may be fabricated of tapered insulation, not to exceed 4" thick.
- Design the project to allow for one complete re-roofing without removal of the existing roof system, should the College decide to do so. This includes:
 - Structural load capacity
 - Camber and deflection
 - Parapet heights
 - Joints, drains, and flashings
- Ensure that the design makes adequate allowance for proper flashing of perimeters and penetrations. Sufficient vertical dimension to install the cant strip, base flashing, counter flashing, and coping, will result in a parapet at least 18" above the finished roof at the highest point of the roof slope. Include a specific detail in the construction documents. This includes:
 - Parapet walls
 - Partial roof structures
 - Equipment curbs and platforms
 - Door and window sills
- Do not assume that base flashings and counter flashing can be successfully nailed into concrete or masonry. Provide a 3/4" plywood nailer at all parapets.

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- Do not use interior roof drains without the specific permission of the Project Coordinator. When unavoidable, provide positive overflow drainage, preferably with a scupper through the parapet wall to daylight, or with a complete separate parallel overflow drain system.
- Design all roof drains and overflow drains in a depressed sump.
- Reroofing must comply with the requirements for new installations as much as possible. The Consultant is responsible for preparing complete details and specifications for the required reroofing work.
- Roofing repairs (e.g. installation of a new exhaust fan), must comply with the requirements for new installations as much as possible. The Consultant is responsible for preparing complete details and specifications for the required repair work. Generic notes such as "flashing as required" are not acceptable. While the College is not interested in telling the Consultant whether the Architect or the Mechanical Engineer should prepare the details and specifications for this type of repair, the information must be thorough and complete regardless of the author.

End of Section 07 00 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 10 00 - Dampproofing and Waterproofing

Introduction

Waterproofing and dampproofing are not interchangeable materials. Project may have one, both, or neither.

Waterproofing is a relatively secure system, and is used on surfaces, which enclose habited space and where moisture penetration is not acceptable.

Damp proofing is a less restrictive system, and is used to reduce moisture migration through exterior surfaces such as retaining walls and planters.

Where such surfaces are intended to be subject to foot traffic, and therefore are not "roofs", refer to the requirements of Section 07 59 00 - Horizontal Traffic Surfacing.

Pay particular attention to the drainage course against the wall and to perimeter drains. Describe requirements for these elements on the drawings.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of manufacturer's literature describing the system, and samples of proposed membrane materials.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Specify expanded warranties as follows:
 - 5-year warranty from the installer covering defects in installation.
 - 10-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof or damp-proof condition (as applicable) for the life of the warranty.
 - Include sealing of all perimeters, joints, and penetrations.
 - Renewal option for an additional 10 years from the materials manufacturer.
 - Full replacement value without proration.

Part 2 - Products

- Asbestos-containing materials are expressly prohibited.
- Require that all materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.

- Specify a waterproofing system which includes the following:
 - Joint preparation.
 - Continuous self-healing sheet membrane, or
 - Fluid-applied membrane which cures in place to form a continuous monolithic self-healing membrane.
 - Termite-resistant protection board embedded in a fluid-applied coating to prohibit displacement.

- Specify a dampproofing system which includes the following:
 - Joint preparation.
 - At least two layers of trowel-grade bituminous coating with interweaved mesh membrane reinforcement.
 - Termite-resistant protection board embedded in bituminous coating to prohibit displacement.

Part 3 - Execution

- Require that the in-progress installation be observed by the materials manufacturer to ensure that the complete assembly will qualify for the required warranty.

- Require that all penetrations be installed in the wall prior to membrane application, so the membrane installer can properly seal them. Avoid the installation of unnecessary sleeves and pay particular attention to the detailing of those that are required.

- All Pima Community College roofs should be coated with acrylic elastomeric with solid of 50% or better.

End of Section 07 10 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 18 00 - Traffic Coatings

Introduction

Systems described under this Section are intended to be installed on exterior walking surfaces that do not enclose habited space.

Where horizontal surfaces enclosing habited spaces are intended to be regularly occupied or otherwise used for the building occupants' activities, refer to the requirements of Section 07 59 00 - Horizontal Traffic Surfacing.

Specify a complete traffic topping system, making the materials manufacturer responsible for the roofing and flashing system. Require the materials manufacturer to make periodic inspections of the work in progress to ensure that the completed work will qualify for the required warranties.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Traffic topping repairs and modifications, which are part of a renovation project, should follow these standards as much as possible. Existing warranties must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "flashing as required" notes are not acceptable.

Be sure to coordinate specification requirements with traffic topping, flashing, and parapet wall details.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of manufacturer's literature describing the system, and samples of proposed membrane materials.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Traffic topping is a finish material, not a staging platform for further construction work. Include the following provisions:
 - Specifically prohibit "phased installation" of traffic topping.
 - Specifically prohibit patches in the finished membrane.
 - Require that finished decks be protected with plywood sheets for any and all construction traffic, and that all equipment moving be accomplished with rollers.
- Specify expanded warranties as follows:
 - 5-year warranty from the installer covering defects in installation.
 - 10-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof condition for the life of the warranty.
 - Renewal option for an additional 10 years from the materials manufacturer.
 - Full replacement value without proration.

- Include all components of the traffic topping assembly, from the deck up.
- Include sealing of all perimeters, joints, and penetrations.
- Both furnished on the College's special warranty form.

Part 2 - Products

- Expressly prohibit the use of asbestos-containing materials.
- Require that all primary and secondary materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify a manufacturer's standard traffic topping system as follows:
 - UL Class A fire rating.
 - Manufacturer's proprietary primer.
 - Fully-adhered, fabric-reinforced, rubberized urethane waterproof membrane.
 - Elastomeric polyurethane wear surface, with integral color and slip-resistant finish.
 - Minimum system thickness 225 mils.
 - Integral cove flashing.

Part 3 - Execution

- Specifically require the traffic topping to be installed in accordance with the manufacturer's recommendations.
- Refer to and describe the appropriate SMCNA details for each edge and penetration condition.
- Require the traffic topping installer to receive, accept, and install, all sheet metal flashings.
- Specifically prohibit:
 - Pitch pans.
 - Guy wires fastened directly to the deck.
- Specify (or detail) 3/4" plywood nailers at all parapet walls.
- Require a spray test after completion of the roofing system, to be witnessed by the Contractor, Architect, Owner, materials manufacturer, and installing contractor(s).

End of Section 07 18 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 20 00 – Thermal Protection

Introduction

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

This section includes insulation used for thermal purposes, and which is installed as an independent material. Insulation that is an integral of a specific system (e.g. membrane roofing or exterior insulation and finish systems), is described in the appropriate Sections.

Such insulation may be included in the total assembly R-value. However, such insulation must not be the sole source of thermal resistivity for the building.

Design building surfaces that experience a significant temperature differential across their thickness to meet the following thermal resistance ("aged R-value") criteria:

- R-19 at walls
- R-30 at roofs and exposed floors

Do not specify any form of insulation to be laid directly on accessible ceilings. Instead, detail horizontal insulation at the top of the cavity, and extend vertical insulation up to that level.

Part 1 - General

- Replace all insulation that becomes wet.

Part 2 - Products

- Expressly prohibit the use of asbestos-containing materials.
- Specify only molded or extruded polystyrene board, or fiberglass batt, insulation.
- With code required vapor barriers to be provided at exterior wall construction, specify required fiberglass insulation to be un-faced. Specify un-faced fiberglass insulation at interior wall locations needing insulation.
- Use blown-in insulations or sound proofing only in remodeling projects where the wall or ceiling/roof assembly is inaccessible for installation of board or blanket materials, and only with specific permission of the PCC Facilities Project Manager.

Part 3 - Execution

- Specify mechanical attachment for all insulation. Do not specify insulation to be adhesive applied or installed loose.

End of Section 07 20 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 24 00 - Exterior Insulation and Finish Systems

Introduction

Use only Type PM (mechanically attached) systems. Use Type PB (adhesive applied) systems only with specific permission of the PCC Facilities Project Manager.

Consider alternative exterior cladding systems in areas where the finish may be subject to physical abuse. Indicate all required expansion, control, and design joints on the drawings.

Part 1 - General

- Require that all materials manufacturer(s) and applicator(s) demonstrate 5 years of successful installation of similar systems.
- Require that applicators be approved and licensed by the materials manufacturer. Use an approved applicator system as a test for manufacturer approval.
- Specify a special 5-year guarantee against defects in materials and installation; including attachment failure, delamination, cracking, peeling, and fading.
- Require mock-up.

Part 2 - Products

- Require that all materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify only extruded polystyrene insulation board, with Class A flame spread and smoke developed characteristics.
- Specify only acrylic-modified Portland cement adhesive and base coat.
- When required, specify only 100% acrylic, integrally colored finish coat, without the need for additional pigmented coatings.
- Where the system will be exposed to potential physical abuse, specify only manufacturers' standard "high impact" components.
- Show control joint and expansion joint locations or require submittal of same.

Part 3 - Execution

- Specifically require the system to be installed in accordance with the manufacturer's recommendations.
- Require the applicators to maintain a "wet edge" until a natural break point is achieved. Expressly prohibit scaffold lines and cold joints.

End of Section 07 24 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 31 00 - Shingles and Shakes

Introduction

Systems described in this Section are intended to be installed in situations where the roof slope is at least 4 inches per foot, and where the roofs are not intended to receive regular foot traffic for equipment maintenance.

Specify a complete roofing system, making the materials manufacturer responsible for the roofing and flashing system. Require the materials manufacturer to make periodic inspections of the work in progress to ensure that the completed work will qualify for the required warranties.

Do not use roof deck insulation as the only element in the overall building thermal resistance system. Refer to Section 07 20 00 – Thermal Protection.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Shingle roof repairs and modifications, which are part of a renovation project (e.g. installation of a new exhaust fan), should follow these standards as much as possible. Existing roof warranties must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "flashing as required" notes (which often appear on engineering details for new exhaust fans) are not acceptable.

Be sure to coordinate specification requirements with roofing, flashing, and parapet wall details.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of manufacturer's literature describing the system, and samples of proposed shingles.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Shingle roofing is a finish material, not a staging platform for further construction work. Include the following provisions:
 - Require the Contractor to install a "temporary roof" if he desires to "dry-in" the building to allow interior construction to begin or to provide a platform for further exterior construction.
 - Describe this requirement as a "Contractor's Option", that is, if they want to dry-in, they must do so only with a temporary roof.
 - Reference the National Roofing Contractors Association (NRCA) requirements for temporary roofs, including "sacrificial" insulation on metal decks.
 - Specifically prohibit "phased roofing".
 - Require that finished roofs be protected with plywood sheets for any and all construction traffic, and that all equipment moving be accomplished with rollers.
 - Roof should be dried according to the manufacturer's suggested specifications.
- Specify expanded warranties as follows:

- 5-year warranty from the installer covering defects in installation.
- 30-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof condition for the life of the warranty.
- Full replacement value without proration.
- Include all components of the roof assembly, from the deck up.
- Include sealing of all perimeters, joints, and penetrations.
- Both furnished on the College's special warranty form.

Part 2 - Products

- The use of Asbestos-containing materials are expressly prohibited.
- Require that all primary and secondary materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify a manufacturer's standard shingle roofing system as follows:
 - UL Class A fire rating.
 - UL Class 90 wind uplift rating.
 - Minimum 15-lb asphalt saturated underlayment.
 - 30-year fiberglass-reinforced asphalt shingles.
- Limit roof insulation to 2" thick. Specify insulations that provide adequate load-bearing capacity at the 2" thickness.

Part 3 - Execution

- Specifically require the roof to be installed in accordance with the manufacturer's recommendations.
- Refer to and describe the appropriate SMCNA details for each edge and penetration condition.
- Require the roofing installer to receive, accept, and install, all sheet metal flashings.
- Specifically prohibit:
 - Pitch pans.
 - Guy wires fastened directly to the deck.
- Specify (or detail) 3/4" plywood nailers at all parapet walls.
- Require a spray test after completion of the roofing system, to be witnessed by the Contractor, Architect, Owner, materials manufacturer, and installing contractor(s).

End of Section 07 31 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 32 00 – Roof Tiles

Introduction

Systems described in this Section are intended to be installed in situations where the roof slope is at least 4 inches per foot, and where the roofs are not intended to receive regular foot traffic for equipment maintenance.

Specify a complete roofing system, making the materials manufacturer responsible for the roofing and flashing system. Require the materials manufacturer to make periodic inspections of the work in progress to ensure that the completed work will qualify for the required warranties.

Do not use roof deck insulation as the only element in the overall building thermal resistance system. Refer to Section 07 20 00 – Thermal Protection.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Clay tile roof repairs and modifications, which are part of a renovation project (e.g. installation of a new exhaust fan), should follow these standards as much as possible. Existing roof warranties must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "flashing as required" notes (which often appear on engineering details for new exhaust fans) are not acceptable.

Be sure to coordinate specification requirements with roofing, flashing, and parapet wall details.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of manufacturer's literature describing the system, and samples of proposed clay tile.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Clay tile roofing is a finish material, not a staging platform for further construction work. Include the following provisions:
 - Require the Contractor to install a "temporary roof" if he desires to "dry-in" the building to allow interior construction to begin or to provide a platform for further exterior construction.
 - Describe this requirement as a "Contractor's Option", that is, if he wants to dry-in, he must do so only with a temporary roof.
 - Reference the National Roofing Contractors Association (NRCA) requirements for temporary roofs, including "sacrificial" insulation on metal decks.
 - Specifically prohibit "phased roofing".
 - Specifically prohibit all traffic from the finished roof.
- Specify expanded warranties as follows:
 - 5-year warranty from the installer covering defects in installation.

- 10-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof condition for the life of the warranty.
- Renewal option for an additional 10 years from the materials manufacturer.
- Full replacement value without proration.
- Include all components of the roof assembly, from the deck up.
- Include sealing of all perimeters, joints, and penetrations.

Part 2 - Products

- Require that all primary and secondary materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify a manufacturer's standard clay tile roofing system as follows:
 - UL Class A fire rating.
 - UL Class 90 wind uplift rating.
 - Minimum 30-lb asphalt saturated underlayment.
 - Barrel or tapered clay mission tile, closely approximating the existing College context in both color and form.
- Limit roof insulation to 2" thick. Specify insulations that provide adequate load-bearing capacity at the 2" thickness.

Part 3 - Execution

- Specifically require the roof to be installed in accordance with the manufacturer's recommendations.
- Specify only galvanized wire-tied tile installation.
- Refer to and describe the appropriate SMCNA details for each edge and penetration condition.
- Require the roofing installer to receive, accept, and install, all sheet metal flashings.
- Specifically prohibit:
 - Pitch pans.
 - Guy wires fastened directly to the deck.
- Specify (or detail) 3/4" plywood nailers at all parapet walls.
- Require a spray test after completion of the roofing system, to be witnessed by the Contractor, Architect, Owner, materials manufacturer, and installing contractor(s).

End of Section 07 32 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 41 00 - Roof Panels

Introduction

Systems described in this Section are intended to be installed in situations where the roof slope is at least 2-1/2 inches per foot, and where the roofs are not intended to receive regular foot traffic for equipment maintenance.

Specify a complete roofing system, making the materials manufacturer responsible for the roofing and flashing system. Require the materials manufacturer to make periodic inspections of the work in progress to ensure that the completed work will qualify for the required warranties.

Do not use roof deck insulation as the only element in the overall building thermal resistance system. Refer to Section 07 20 00 – Thermal Protection.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Metal roof repairs and modifications, which are part of a renovation project (e.g. installation of a new exhaust fan), should follow these standards as much as possible. Existing roof warranties must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "flashing as required" notes (which often appear on engineering details for new exhaust fans) are not acceptable.

Be sure to coordinate specification requirements with roofing, flashing, and parapet wall details.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of:
 - Manufacturer's literature describing the system.
 - Shop drawings showing panel layout, and all edge, transition, and penetration details.
 - Samples of proposed metal panels.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Metal roofing is a finish material, not a staging platform for further construction work. Include the following provisions:
 - Require the Contractor to install a "temporary roof" if he desires to "dry-in" the building to allow interior construction to begin or to provide a platform for further exterior construction.
 - Describe this requirement as a "Contractor's Option", that is, if he wants to dry-in, he must do so only with a temporary roof.
 - Reference the National Roofing Contractors Association (NRCA) requirements for temporary roofs, including "sacrificial" insulation on metal decks.
 - Specifically prohibit "phased roofing".
 - Specifically prohibit all traffic from the finished roof.

- Specify expanded warranties as follows:
 - 5-year warranty from the installer covering defects in installation.
 - 30-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof condition for the life of the warranty.
 - Full replacement value without proration.
 - Include all components of the roof assembly, from the deck up.
 - Include sealing of all perimeters, joints, and penetrations.

Part 2 - Products

- Require that all primary and secondary materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify a manufacturer's standard preformed metal roofing system as follows:
 - UL Class A fire rating.
 - UL Class 90 wind uplift rating.
 - Minimum 15-lb asphalt saturated underlayment.
 - Factory formed panels, steel, aluminum, or copper.
 - Concealed fastener installation.
 - Factory applied polyvinylidene fluoride finish, or natural metal finish intended for exposure to the elements.
- Limit roof insulation to 2" thick. Specify insulations which provide adequate load-bearing capacity at the 2" thickness.
- Minimum gauges
 - Roofs: 22-gauge
 - Walls: 18-gauge
- Minimum panel width 12"

Part 3 - Execution

- Specifically require the roof to be installed in accordance with the manufacturer's recommendations.
- Refer to and describe the appropriate SMCNA details for each edge and penetration condition.
- Require the roofing installer to receive, accept, and install, all sheet metal flashings.
- Specifically prohibit:
 - Pitch pans
 - Guy wires fastened directly to the deck
- Specify (or detail) 3/4" plywood nailers at all parapet walls.
- Require a spray test after completion of the roofing system, to be witnessed by the Contractor, Architect, Owner, materials manufacturer, and installing contractor(s).

End of Section 07 41 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 50 00 - Membrane Roofing

Introduction

Systems described under this section are not intended to receive regular foot traffic. Occasional traffic for maintenance of equipment is acceptable.

Where horizontal surfaces enclosing habited spaces are intended to be regularly occupied or otherwise used for the building occupants' activities, refer to the requirements of Section 07 59 00 - Horizontal Traffic Surfacing.

Specify a complete roofing system, making the materials manufacturer responsible for the roofing and flashing system. Require the materials manufacturer to make periodic inspections of the work in progress to ensure that the completed work will qualify for the required warranties.

The College uses a built-up SBS-modified bitumen roofing system, applied either hot mopped, self-adhered or cold emulsion, in virtually all conditions. Use of other roofing systems must receive specific permission from the Project Manager.

- Gravel surface roofs must NOT be specified.
- Torch-applied materials of any kind shall NOT be specified.
- Single-ply roofs must NOT be specified.
- Asbestos-containing materials must NOT be specified.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Membrane roof repairs and modifications, which are part of a renovation project (e.g. installation of a new exhaust fan), should follow these standards as much as possible. Existing roof warranties must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "flashing as required" notes (which often appear on engineering details for new exhaust fans) are not acceptable.

Be sure to coordinate specification requirements with roofing, flashing, and parapet wall details.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of manufacturer's literature describing the system, and samples of proposed membrane materials.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Membrane roofing is a finish material, not a staging platform for further construction work. Include the following provisions:
 - Require the Contractor to install a "temporary roof" if he desires to "dry-in" the building to allow interior construction to begin or to provide a platform for further exterior construction.

- Describe this requirement as a "Contractor's Option", that is, if he wants to dry-in, he must do so only with a temporary roof.
 - Reference the National Roofing Contractors Association (NRCA) requirements for temporary roofs, including "sacrificial" insulation on metal decks.
 - Specifically prohibit "phased roofing".
 - Specifically prohibit patches in the finished roof.
 - Require that finished roofs be protected with plywood sheets for any and all construction traffic, and that all equipment moving be accomplished with rollers.
- Specify expanded warranties as follows:
 - 5-year warranty from the installer covering defects in installation.
 - 20-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof condition for the life of the warranty.
 - Full replacement value without proration.
 - Include all components of the roof assembly, from the deck up.
 - Include sealing of all perimeters, joints, and penetrations.
 - Both warranties shall be furnished on the College's special warranty form. Any reference to maximum wind speed on the warranty shall not supersede the requirement to provide a UL Class 90 uplift rating.
 - Calculate insulation thickness to allow for 8" minimum clearance for all roof penetrations, doors, curbs, windows, etc.

Part 2 - Products

- Require that all primary and secondary materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify a manufacturer's standard built-up roofing system as follows:
 - UL Class A fire rating.
 - UL Class 90 uplift rating.
 - Rigid overlayment or cover board on top of insulation to increase roof durability and hail resistance.
 - 2-ply SBS-modified bitumen system. (Base sheet + mineral surface cap sheet)
 - Reflective roof coating to meet project Solar Reflectance Index. Apply after all work is complete and roof is accepted.
 - Applied with either hot asphalt mop, self-adhered or cold emulsion.
- Care should be taken in the selection of tapered rooftop insulation and rigid overlayment board to insure a durable roof surface that will hold up to maintenance activities for the life of the roof and will not compress over time under various loads. Lightweight insulating concrete can also be considered if project conditions and budget dictate.

Part 3 - Execution

- Specifically require the roof to be installed in accordance with the manufacturer's recommendations.
- Refer to and describe the appropriate SMCNA details for each edge and penetration condition. Require the roofing installer to receive, accept, and install, all sheet metal flashings.
- Specifically prohibit:

- Pitch pans.
- Guy wires fastened directly to the deck.

- Specify (or detail) 3/4" plywood nailers at all parapet walls.

- Require a spray test after completion of the roofing system, to be witnessed by the Contractor, Architect, Owner, materials manufacturer, and installing contractor(s). Do not require a flood test.

End of Section 07 50 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 59 00 - Horizontal Traffic Surfacing

Introduction

Systems described under this Section are intended to be installed on exterior walking surfaces, which enclose habited space.

Where horizontal surfaces that do not enclose habited spaces are intended to be regularly occupied or otherwise used for the building occupants' activities, refer to the requirements of Section 07 60 00 - Traffic Topping.

Specify a complete horizontal traffic surfacing system, making the materials manufacturer responsible for the surfacing and flashing system. Require the materials manufacturer to make periodic inspections of the work in progress to ensure that the completed work will qualify for the required warranties.

Do not use traffic deck insulation as the only element in the overall building thermal resistance system. Refer to Section 07 20 00 – Thermal Protection.

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Horizontal traffic surfacing repairs and modifications, which are part of a renovation project, should follow these standards as much as possible. Existing warranties must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "flashing as required" notes are not acceptable.

Be sure to coordinate specification requirements with traffic surfacing, flashing, and wall details.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar systems.
- Require submittal of:
 - Manufacturer's literature describing the system.
 - Samples of proposed membrane materials.
 - Samples of the proposed pavers.
- Require a pre-installation conference, scheduled after the substrates are complete, and including the Contractor, Architect, Owner, materials manufacturer, and installing subcontractor(s).
- Horizontal traffic surfacing is a finish material, not a staging platform for further construction work. Include the following provisions:
 - Require the Contractor to install a "temporary roof" if he desires to "dry-in" the building to allow interior construction to begin or to provide a platform for further exterior construction.
 - Describe this requirement as a "Contractor's Option", that is, if he wants to dry-in, he must do so only with a temporary roof.

- Reference the National Roofing Contractors Association (NRCA) requirements for temporary roofs, including "sacrificial" insulation on metal decks.
 - Specifically prohibit "phased" traffic surfacing installation.
 - Specifically prohibit patches in the finished membrane.
 - Require that finished systems be protected with plywood sheets for any and all construction traffic, and that all equipment moving be accomplished with rollers.
- Specify expanded warranties as follows:
 - 5-year warranty from the installer covering defects in installation.
 - 10-year warranty from the materials manufacturer including defects in materials and installation, and guaranteeing to maintain the system in a waterproof condition for the life of the warranty.
 - Renewal option for an additional 10 years from the materials manufacturer.
 - Full replacement value without proration.
 - Include all components of the traffic surfacing assembly, from the deck up, including removal and reinstallation of the pavers.
 - Include sealing of all perimeters, joints, and penetrations.
 - Both furnished on the College's special warranty form.

Part 2 - Products

- Expressly prohibit the use of asbestos-containing materials.
- Require that all primary and secondary materials be supplied by a single manufacturer, or approved by the primary materials manufacturer, to ensure single-point responsibility for the installation and warranty.
- Specify a manufacturer's standard horizontal traffic surfacing system as follows:
 - UL Class A fire rating.
 - Fabric-reinforced fully-adhered, rubberized asphalt membrane, 225 mils minimum thickness.
 - Integral cove flashing.
 - Manufacturer's proprietary protection sheet.
 - Manufacturer's proprietary drainage sheet.
 - 1" thick, cfc-free, extruded polystyrene foam insulation, approved by horizontal traffic surfacing system manufacturer.
 - Precast concrete pavers.
 - Special attention shall be given so as to ensure that concrete pavers provide appropriate slip resistance. Stained, coated or painted pavers are expressly prohibited.

Part 3 - Execution

- Specifically require the horizontal traffic surfacing to be installed in accordance with the manufacturer's recommendations.
- Refer to and describe the appropriate SMCNA details for each edge and penetration conditions.
- Require the traffic surfacing installer to receive, accept, and install, all sheet metal flashings.
- Specifically prohibit:
 - Pitch pans

- Guy wires fastened directly to the deck
- Specify (or detail) 3/4" plywood nailers at all parapet walls.
- Require a spray test after completion of the roofing system, to be witnessed by the Contractor, Architect, Owner, materials manufacturer, and installing contractor(s).

End of Section 07 59 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 60 00 - Flashing and Sheet Metal

Introduction

Wherever possible, describe flashing systems, which use concealed fasteners, clips, and cleats. Where exposed fasteners are unavoidable, specifically describe a fastening system which absolutely prohibits entrance of water, and which will remain watertight for the life of the facility.

Wherever possible, avoid reliance on sealants as the sole means of prohibiting entrance of water. Use matching materials on renovations of existing buildings, which contain copper flashing materials.

Describe all requirements for installation of sheet metal work, which is associated with the roofing system and its special warranties in the appropriate roofing section, to maintain single-point responsibility for the roof warranty.

Describe all requirements for sealants in Section 07 90 00 – Joint Protection.

Specifically detail all conditions on the drawings, including references to specific requirements of the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) "Architectural Sheet Metal Manual".

Part 1 - General

- Require submittal of shop drawings and details of each condition and joint.

Part 2 - Products

- Specify minimum 24 gauge thickness for galvanized metal, and identify specific heavier gauges where the project requires.

-OR-

Specify minimum 16 ounce for copper, and identify specific heavier materials where the project requires.

- Use only minimum 16-ounce copper for masonry through-wall, lintel, or other similar embedded flashings.
- Use only 4-pound lead for roof drain sump pans.
- When necessary, use 4-pound lead for flashings involving compound curves or where sheet metal cannot be adequately formed. This application requires a galvanized sheet metal protective cover.
- Where 2-piece reglets are required, describe the specific shape and substrate conditions, but do not reference proprietary manufacturer's products.
- Do not specify roof jacks or boots, which utilize integral neoprene seals.
- Use only galvanized structural steel tube or pipe for downspout sections, which are subject to impact and abuse.
- Specify only 50/50 tin/lead solder when applicable.

- Specify only non-corrosive fasteners, same material as metal being fastened, with matching finish on exposed heads. Specify neoprene-backed washers for screw fasteners.

Part 3 - Execution

- Specifically describe requirements for expansion and contraction joints, and for sealing joints in running flashings. Do not rely on generic "provide expansion joints as required" notes.
- Specifically design joints to allow for removal and reinstallation of flashings during re-roofing. Two-piece reglets are preferred.
- Specifically describe requirements for separating dissimilar metals.

End of Section 07 60 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 70 00 - Roof and Wall Specialties and Accessories

Introduction

Include all items which become an integral part of the roof moisture protection system in this Section.

In certain limited situations where items are more appropriately described in other sections (e.g. prefabricated mechanical equipment curbs), make specific cross references in both sections, and require the installation of those items to comply with the requirements of the appropriate Division 07 – Thermal and Moisture Protection Section(s).

Describe all requirements for installation of roof accessories, which are associated with the roofing system and its special warranties in the appropriate roofing section, to maintain single-point responsibility for the roof warranty.

Accessories that require structural support (e.g. antennae) must be supported from the building structure. Do not specify and expressly prohibit attachments through the roof membrane, and guy wires.

Items that must pass through the roof membrane (e.g. antennae cables) must pass through a conduit. Do not specify and expressly prohibit penetrations directly through the membrane, and cables snaked through other penetrations.

Detail and specify burglar bars (6" maximum spacing each way) in all situations where roof deck openings would otherwise allow entry to the building.

Part 1 - General

- Require submittal of manufacturer's literature, and installation details.

Part 2 - Products

- Specify only metal accessories. Specifically prohibit use of PVC and other plastics.
- Wherever possible, specify accessories, which have integral curbs sufficiently tall to permit secure installation of flashing and counter flashing.
- Where roof accessories are not ordinarily curbed, specify and detail custom fabricated curbs.
- Avoid as much as possible accessory units which rely on flat flanges to permit secure application of roof membrane.

Part 3 - Execution

- There are no unique College requirements in this section.

End of Section 07 70 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 80 00 – Fire and Smoke Protection

Introduction

Indicate on the drawings the UL Listing Number and fire resistance rating that is required for each condition of structural fireproofing.

Fireproofing systems which are part of a renovation project (e.g. repair of damaged or missing systems, or removal and replacement of existing systems) should follow these standards. Existing fire resistance ratings must not be compromised. The consultant must prepare a complete specification and details for the required repair work. Generic "repair fireproofing as required" notes are not acceptable.

This is a section where the Consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Part 1 - General

- Require that all materials manufacturer(s) and applicator(s) demonstrate 5 years of successful installation of similar materials.
- Require submittal of manufacturer's literature describing all materials, and the specific systems to be applied for this project.

Part 2 - Products

- Specifically prohibit the use of asbestos containing materials.
- When re-fireproofing structural elements where the College has abated asbestos-containing fireproofing, specify only materials that are known to be compatible with asbestos encapsulants.

Part 3 - Execution

- Describe requirements for protection of completed fireproofing.
- Describe specific requirements for repair of fireproofing in the event of damage.
- When re-fireproofing structural elements where asbestos-containing fireproofing has been spot-abated by the College, specifically describe precautions that the Contractor must take to protect adjoining asbestos-containing fireproofing which remains.

End of Section 07 80 00

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 84 00 - Firestopping

Introduction

Describe in this Section all requirements for firestopping wall penetrations, floor penetrations, ceiling penetrations, and joints. Do not rely on general references in the sealants section. This includes boards, blankets, modules, pillows, tapes, caulks, foams, intumescent, and other similar materials.

Specifically describe on the drawings all requirements for installation of firestopping. Generic notes such as "firestopping as required" are not acceptable. Reliance on the Contractor understanding the building code and "complying at no additional cost" is similarly not acceptable.

This is a section where the Consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Part 1 - General

- Require that materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar materials.
- Require submittal of complete manufacturer's literature, including UL test results for each material-and-application system required for the project.
- It is desirable to have all trades use the same product.

Part 2 - Products

- Specify each type of firestopping material required in the project.
- Product shall be trowallable and paintable.

Part 3 - Execution

- Label all fire rated walls to include above concealed or accessible ceilings and below raised access floors. Minimum 3" red lettering shall say (1 or 2 Hr. Fire Rated). Depending on rating, labeling to be a maximum 15' from end of walls and a maximum 30' O.C.
- Provide a schedule identifying location and type of firestopping.
- Require installation of sleeves at all wall, floor, and ceiling penetrations.
- Specifically require firestopping materials to be installed in accordance with the manufacturer's recommendations.
- Specifically require that all firestopping be observed as complete prior to being covered by other work.

End of Section 07 84 00

DIVISION 07 -THERMAL AND MOISTURE PROTECTION

Section 07 90 00 – Joint Protection

Introduction

Describe all requirements for installation of sealants required to prohibit the penetration of moisture and dust, and required to seal joints between dissimilar materials, in this section.

Specify certain specialized sealants, which are ordinarily part of a "complete in place" installation by a particular trade (e.g. glazing sealants and painting) in the appropriate sections.

Reliance on caulking which might (or might not) be provided by a painter as part of that finish operation, as the moisture-or dust-seal, is unacceptable.

Pay particular attention in sealant system design to expected joint movement, joint dimensions, sealant position (horizontal, vertical, or overhanging), and potential for physical abuse of the sealed joint.

Specifically describe and detail on the drawings all joints requiring installation of sealants. Generic notes such as "sealant as required" are not acceptable.

This is a section where the Consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Part 1 - General

- Require that all materials manufacturer(s) and installer(s) demonstrate 5 years of successful installations of similar materials.
- Require submittal of the following:
 - Manufacturer's literature documenting compliance with specification requirements.
 - Actual sealant samples for color selection.
 - Sample joints, where unique conditions require.
- Maximum allowable exterior joint width, for caulking/sealant, shall not exceed 1".

Part 2 - Products

- Specify each particular type of sealant and sealant system required, including:
 - Primers
 - Backers
 - Fillers
 - Colors
- Expressly prohibit the use of latex and butyl sealants.
- Specify only non-staining materials.

Part 3 – Execution

- Provide a sealant schedule identifying location and type of sealant.
- Specifically require sealants to be installed in accordance with the manufacturer's recommendations.
- Specifically require all joints to be observed by the Owner prior to installation of sealants.

End of Section 07 90 00

DIVISION 08 - OPENINGS

Section 08 00 00 - General Discussion

Introduction

This General Discussion Section contains material which is critical to successful door and window installations, in new construction and renovation, but which is not the sole responsibility of any individual trade. In many cases, the issues involved are fundamental to the basic design of the project, and the success or failure of this element of the project is determined at the very outset of the design process.

The Consultant is expressly responsible for incorporating these overall requirements into the project, and for ensuring that all sub consultants are aware of the requirements and incorporate them into their designs as well.

Reliance on "after-the-fact" material selections to compensate for a problematic design decision is unacceptable.

The use of wired fire rated safety glass has been determined an undesirable safety risk and is no longer allowed. Consequently, glazed openings in fire rated doors and windows will require the use of fire rated glass.

Major Entrances

- Generally, major building entrances will utilize some sort of monumental storefront system. All other exterior doors and frames should be steel.

Multiple Doors, Pairs of Doors, Banks of Doors

- Exit widths in excess of 3'-0" are often required in major facilities. In such instances, the College prefers to use banks of single leaf doors, rather than double doors with center mullions. This requirement includes the following situations:
 - Major building entrances
 - Assembly occupancy entrance/exits (both interior and exterior)
- In such situations that also require large widths for passage of equipment, use wider door leaves. Preferably, use overhead doors as the primary means for passage of equipment.
- Since the College does not use vertical rod exit devices, pairs of doors will necessarily have center mullions. In situations where use of center mullions is unavoidable and which also require large widths, the mullions must be removable. Specify these mullions in Section 08 70 00 - Hardware.
- Do not specify center mullions for double-egress doors in corridors.

Large Interior Doors

- Where interior spaces require large doors for the passage of equipment (e.g. general laboratories, shared equipment laboratories, etc.), specify 3'-6" or 4'-0" single leaf doors (with appropriate adjustments in frame gauge and hardware requirements) rather than pairs of 3'-0" + 1'-0" doors.

Coordination and Preparation

- Make specific references to ensure that requirements for coordination of doors, frames, and hardware, is clearly included in the Contractor's scope of work. This often involves the steel door and frame supplier, the wood door supplier, the hardware supplier, and the installers of these materials. While this type of coordination is implicit in the Contractor's scope, a specific reference provides an additional level of comfort.
- A common example of the lack of this coordination is an interior wood door in a steel frame with a smoke gasket. If even one of the trades involved fails to properly coordinate, it is likely the door will not close and latch properly against the gasket.
- The Consultant should also ensure during submittal review that such issues are clearly identified in the submittals of all the trades involved.

End of Section 08 00 00

DIVISION 08 - OPENINGS

Section 08 11 00 - Metal Doors and Frames

Introduction

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Do not specify knock-down or so-called "drywall" metal door frames.

Part 1 - General

- Require that all steel doors and frames comply with the requirements of:
 - National Association of Architectural Metal Manufacturers Standard HMMA 861
 - Building Hardware Manufacturer's Association (BHMA)
 - Underwriter's Laboratories (UL) rated and labeled where required
- Require submittal of:
 - Manufacturer's literature
 - Shop drawings
 - Complete door and frame schedule covering every opening

Part 2 - Products

- Specify doors and frames in the following gauges:
 - Exterior frames: 14 gauge
 - Interior frames > 4'-0": 14 gauge
 - Interior frames < 4'-0": 16 gauge
 - Doors: 18 gauge
- Specify doors and frames with factory-applied primer, ready for field finishing.
- Specify and detail door frames with:
 - Fully mitered, welded, and ground corners
 - Double rabbeted profiles, with equal-sized rabbets
 - 2" rails and head, and always equal-size
 - Exterior sidelights and transoms for interior glazing only
 - Lights which extend to the floor with 4" bottom rails
 - Mortar boxes for all hardware
 - ASA strikes for full mortise locks
 - 4 wall anchors plus 2 drilled floor anchors per jamb
 - Corrugated 14 gauge T-type for masonry walls
 - Welded to frame for stud walls
 - Weld jamb clips at metal stud walls to door frame
 - Use dimpled anchors only for openings in existing walls
 - Silencers on all frames

- Specify and detail doors with:
 - Seamless faces
 - Edge seams welded and ground
 - Rigid polystyrene core fully bonded to the steel face sheets or honey comb
 - Closed watertight top
 - Inverted bottom closure channel
 - Minimum 6" head rail, 6" stiles, and 12" bottom rail, at all lights and louvers
 - Provide pockets for full mortise lock
- Specifically require that doors and frames be prepared and internally reinforced at the factory for installation of butts, closers, locksets, exit devices, and all other scheduled hardware. Specifically prohibit field preparation of steel doors and frames.
- Make specific reference that the rabbet of door frames be sized, and that factory preparation for butts in both doors and frames must make allowance, for silencers or smoke gaskets.

Part 3 - Execution

- Specifically require that all doors and frames be installed in conformance with HMMA, BHMA, and UL requirements.
- Require that all doors be completely hung, with all hardware installed, tested, and adjusted for perfect fit, prior to field finishing. Require that doors be dismantled and hardware removed, and re-hung after finishing is complete.

End of Section 08 11 00

DIVISION 08 - OPENINGS

Section 08 14 00 - Wood Doors

Introduction

This is a section where the consultant should use a "performance specification". Do not specify doors by proprietary manufacturer's names or model numbers, and do not restrict vendors to a limited list.

Do not specify wood doors for exterior applications.

Part 1 - General

- Reference the following standards as applicable and coordinate specifications to comply without conflicts.
 - Architectural Woodwork Institute (AWI) Quality Standards, Section 1300 Architectural Flush Doors, current edition
 - Window & Door Manufacturers Association (WDMA), ANSI/WDMA I.S 1-A-97 Wood Flush Doors
 - NFPA 80 – Fire Doors and Windows
 - NFPA 252 – Fire Test for Door Assemblies
 - ASTM E152 – Fire Tests of Door Assemblies
 - UL 10B – Fire Tests of Door Assemblies
- Require these associations' stamps and labels to be affixed to the doors.
- Require submittal of manufacturer's literature, and 6"x6" corner samples.
- Require doors to be wrapped in plastic. Individual cartoning is not required.
- Specify full lifetime guarantee for interior wood doors. Include defective materials and fabrication, delamination, warping, telegraphing. Include replacement, reinstallation, and refinishing of the door.

Part 2 - Products

- Specify only 1-3/4" thick solid core doors for all interior applications.
- Specify doors complying with AWI "premium grade", PC7 ME or PC5 ME with select white birch veneer faces, rotary cut, book-matched grain, balance matched assembly, for transparent finish. For new buildings, alternative veneers require project manager approval.
- Specify particle board cores, with stiles and rails glued to core and sanded before laminating, for general non-rated applications, and for 20-minute fire-rated applications.
- Specify mineral cores of appropriate ratings, with stiles and rails glued to core and sanded before laminating, where 3/4-hour or longer fire-rated doors are required.
- Require solid wood blocks in fire-rated doors as support for installation of mortise and/or cylinder type locksets (2-3/4" backset), and of closers.
- Require rails and stiles of solid hardwood (not laminated or veneered), 1-1/8" minimum for rails, and 1-3/8" minimum for stiles.

- Require surrounds for lite and louver openings for non-rated doors of solid hardwood (not laminated or veneered), 6" minimum.
- Specify glazing stops of same hardwood as door facing.
- Require rated metal surrounds and glazing for lites at rated doors. Require profile of rated surround to match profile of specified wood surrounds of non-rated doors.
- Specify pair matched, set matched and continuous matched transoms, where applicable.
- Specify only Type I adhesives for all applications.
- Specify minimum STC 35 sound rating for single leaf doors for most applications. Discuss requirements for higher STC ratings with the Project Manager.

Part 3 - Execution

- Specify installation using the following criteria:
 - Bevel doors on 3 sides
 - Trim doors to provide 1/8" reveal on 3 sides
 - If beveling or trimming is required, seal all surfaces to prevent swelling
 - Machine, trim, and mount doors to receive all specified items of hardware (especially smoke gaskets and weather strips), and to latch without binding

End of Section 08 14 00

DIVISION 08 - OPENINGS

Section 08 31 00 - Access Doors and Panels

Introduction

Provide access doors to attics, roofs, crawl spaces, tunnels, elevator equipment rooms, overhead areas, mechanical equipment rooms, and similar spaces where College personnel must have access for maintenance or repair.

All access doors shall be specified in this section. Coordinate with work in other divisions (i.e., electrical and mechanical). On architectural drawings, show all access doors on ceiling plans and on wall elevations.

Part 1 - General

- Minimum size shall be 16" x 16" for walls and 24" x 24" for ceilings. Size may be larger if required for replacement of materials/equipment.
- Access doors shall be fire rated where required. Locations should be noted on plans.
- All access doors shall be metal.
- Provide key locks only on doors to elevator equipment areas

Part 2 - Products

- Access doors shall have continuous hinges and a minimum of two (2) cam type latches.

Part 3 - Execution

- Access doors shall be painted in the open position.

End of Section 08 31 00

DIVISION 08 - OPENINGS

Section 08 33 23 - Overhead Coiling Doors

Introduction

Provide Overhead coiling doors where necessary for service or access. Avoid the use of pairs of swing type doors for service access

Avoid these type doors as part of fire rated wall opening

Avoid the use of security grilles

Where egress is required, provide adjacent (not integral) personnel exit door assembly.

Where an insulated door is required, sectional type shall be provided.

Part 1 - General

- Use manual push up type except where crank, chain or motor operation is appropriate due to size.

Part 2 - Products

- Provide cylinder locking method in bottom bars.

Part 3 - Execution

- Insure that fusible link, if applicable, is accessible on doors used as a fire rated curtain.

End of Section 08 33 23

DIVISION 08 - DOORS AND WINDOWS

Section 08 41 00 - Entrances and Storefronts

Introduction

Evaluate if future reglazing can be accomplished easily from the exterior.

Part 1 - General

- Consultant shall establish the minimum level of quality. System shall be “engineered”.
- Generally, these systems shall not incorporate operable windows.
- System shall accommodate the hardware components specified in Section 08 70 00 - Hardware. Substitutions of manufacturer’s standard hardware is not permitted.

Part 2 - Products

- Finishes shall be noted. If anodized or powder coated give class #.
- Determine if window washing hooks are necessary.
- Require design to provide for a simple re-glazing system.
- Specify the framing system. System shall provide positive drainage to the exterior.
- Entrance doors shall be minimum “wide style” type. Equivalent to Arcadia, Old Castle, or approved equal.

Part 3 - Execution

- There are no unique College requirements.

End of Section 08 41 00

DIVISION 08 - OPENINGS

Section 08 51 00 - Metal Windows

Introduction

Finishes, maintenance and heat loss or gains are important considerations. Double-glazing is required on all exterior windows.

Operable sash for emergency exit from dormitory rooms to meet code requirements must be considered as well as operable sash in air-conditioned buildings where the equipment may fail for some reason.

Institutional quality construction and superior coatings and finishes should be considered if the budget will permit. Interior glazing is preferred, for glass replacement, above the ground floor level.

Part 1 - General

- Require test results for water and air infiltration.
- Require certification that window meets requirements of Steel Window Institute or Aluminum Window Institute.
- Detailing shall provide for drainage, weepage, flashing, etc. for a weather tight installation.

Part 2 - Products

- Require protective coverings if materials are prefinished.

Part 3 - Execution

- There are no unique College requirements.

End of Section 08 51 00

DIVISION 08 - OPENINGS

Section 08 52 00 - Wood Windows

Introduction

Wood windows are to be used only in restoration work on historical buildings.

Part 1 - General

- There are no unique College requirements.

Part 2 - Products

- There are no unique College requirements.

Part 3 - Execution

- There are no unique College requirements.

End of Section 08 52 00

DIVISION 08 - OPENINGS

Section 08 62 00 – Unit Skylights

Introduction

Avoid use of skylights wherever possible. Clerestories and light monitors are superior solutions. Use skylights, clerestories, and monitors only with specific permission of the Project Manager.

Existing skylights, which are part of a renovation project, should always be considered for removal or replacement with alternative light gathering elements. Specifically discuss such situations with the PCC Facilities Project Manager.

Describe all requirements for flashing and sealing of skylights in the appropriate roofing section, to maintain single-point responsibility for the roof warranty.

Skylights that require structural support must be supported from the building structure. Do not specify and expressly prohibit attachments through the roof membrane.

Detail and specify burglar bars (6" maximum spacing each way) in all situations where roof deck openings would otherwise allow entry to the building.

Part 1 - General

- Require submittal of manufacturer's literature, and installation details.

Part 2 - Products

- Specify only double-domed, solar-glazed, steel or aluminum-framed skylights.
- Wherever possible, specify skylights, which have integral curbs sufficiently tall to permit secure installation of flashing and counter flashing.
- Where the required skylight roof is not integrally curbed, specify and detail custom fabricated curbs.
- Do not use skylights, which rely on flat flanges to permit secure application of roof membrane.

Part 3 - Execution

- There are no unique College requirements in this Section.

End of Section 08 62 00

DIVISION 08 - OPENINGS

Section 08 70 00 - Hardware

Introduction

Pima Community College has determined that, based on its experience with the performance and durability of the products described in this Section, and based on the benefits of limiting the range of repair parts that must be maintained in inventory, a proprietary specification is in the best interest of the College.

Specify all hardware required for a fully functioning, secure, weatherproof installation for all swinging, sliding, and folding doors.

Include unique door or frame dependent hardware in those sections.

Include cabinet hardware in the appropriate Division 6 section.

Comply with prevailing codes, standards and accessibility standards for project location.

In renovation projects, existing hardware shall only be reinstalled only if it meets current specifications. Modifications to the room use or orientation shall be reviewed by Access Control to confirm appropriate hardware type. Requiring the Contractor to "match existing as required" is unacceptable.

In special cases, hardware different from those items described below may be required. In all such cases, secure specific permission from the Lock Shop Supervisor through the Project Manager. These cases may include:

Alarmed exit devices
Electronic security access
Matching "period" hardware in historic buildings

Include on the drawings a schedule indicating which specific hardware group applies to each individual door. Pay particular attention to identifying the desired function of each door lockset.

Part 1 - General

- Require submittal of a complete hardware schedule, submitted in a DHI Vertical Format, describing each door and each hardware group, including technical data for each item.
- Require that the supplier of finish hardware have as a full-time employee a regular member of the Door & Hardware Institute (DHI).
- Require delivery to the PCC Lock Shop upon Substantial Completion all adjusting tools, keys, dogging keys, and other maintenance materials (specific to pieces of hardware).
- All hardware to be installed with mounting hardware supplied by the hardware manufacturer.
- Hardware Supplier shall be a stocking dealer physically located in the United States of America.
 - Hardware supplier, PCC Lock Shop and complete project team should participate in submittal phase coordination meetings as needed to complete coordination with all other trades (doors, frames, electrical) and vendors

- Hardware supplier, PCC Lock Shop and complete project team should participate in a pre-installation meeting prior to hardware installation and conduct a post installation review and adjustment of all hardware 3-6 months after occupancy.

Part 2 - Products

- Butts (Hinges);
 - Pre-qualified manufacturers are:
 - Mac Pro
 - Hager
 - McKinney
 - Ives
 - Follow hinge manufacturer’s recommendations for size, type, metal and quantity. Minimum 1-1/2 pair per door
 - Preference is for ball bearing five-knuckle hinges, with non-removable pins and a lifetime warranty for all openings. The same is a requirement for all openings with door closers.
 - Comply with NFPA-80 at rated openings.
- Locksets and Latches;
 - Pre-qualified manufacturer and lockset series is:
 - Schlage Lock, COLLEGE STANDARD
 - Locksets shall accept non-interchangeable core ASSA cylinders only.
 - Permanent cylinders will be provided by PCC Lock Shop.
 - All Schlage lock and latch sets shall be purchased through an authorized, stocking, Allegion Dealer physically located in the United States.
 - On building renovation and expansion projects verify with Facilities Lock Shop for manufacturer and type of locksets required
- Mortise;
 - Use Schlage L Series, labeled, mortise locks, less cylinders, at heavy-duty applications such as those listed below. For additional information, see cylinder and keying section below.
 - As general rule, the COLLEGE STANDARD is for full mortise locksets in all College buildings. Consult with PCC Lock Shop for any exceptions. Mortise locksets are especially crucial in high use heavy-duty applications such as laboratories, classrooms, stairwells, main entries, etc.
 - Use "06A" rose and lever for trim design selection
 - Use Schlage ND Series, non-interchangeable core, cylindrical locksets less cylinders for any general or low use applications subject to Lock Shop approval. For additional information, see cylinder and keying section below.
 - Use "Rhodes (RHO626) and lever trim design selection.
 - Generally use the following functions in the noted applications. User and PCC Lock Shop may require use of other functions.

Passage	Non-locking doors <ul style="list-style-type: none"> • Schlage Mortise Function: L9010S 06A • Schlage Cylindrical Function: ND10S RHO
Privacy	Single person toilet rooms <ul style="list-style-type: none"> • Schlage Mortise Function: L9040S 06 w/occupancy indicator

	<ul style="list-style-type: none"> Schlage Cylindrical Function: ND40S RHO
Storeroom (Always Locked)	<p>Restricted interior applications (animal quarters, bio-hazard labs, radio-hazard labs, etc.) and all interior and exterior service spaces (mechanical rooms, equipment rooms, telecomm rooms, always locked storage rooms, custodial closets, etc.) and ground level stairwell exit only doors that do not require panics.</p> <ul style="list-style-type: none"> Schlage Mortise Function: L9080 L 06A Schlage Electrical Mortise Function: L9092 LEU 06A (EL at fail-safe applications) New construction to be 24 VDC. Verify with PCC Lock Shop for existing voltage. Schlage Cylindrical Function: ND80LD RHO Schlage Electrical Cylindrical Function: ND80LD RHO DEU (DEL at fail-safe applications) at access controlled doors. New construction to be 24VDC. Verify with PCC Lock Shop for existing voltage.
Office	<p>All "assigned" interior applications (offices, laboratories, etc.)</p> <ul style="list-style-type: none"> Schlage Mortise Function: L9050L 06A Schlage Cylindrical Function: ND53LD RHO
Classroom (Key)	<p>All "shared" interior applications (classrooms, lecture halls, etc.)</p> <ul style="list-style-type: none"> Schlage Mortise Function: L9456 06A Schlage Cylindrical Function: ND73LD RHO (Classroom security function is not utilized)
Auxiliary Deadlock	<p>Corridor toilet rooms</p> <ul style="list-style-type: none"> Schlage Mortise Deadbolt: L463 classroom function at multiple user restrooms. Use with push/pulls.

- Vandalguard is not utilized.
 - 2-3/4" backset typical. Exception: Where conflict may exist with sound or other seals conflicting with lock rose.
 - Only 4-7/8" "ASA" type strikes with no filing or other modifications to make fit.
 - Cylindrical latch throw to be 1/2" minimum or 3/4" or as required by opening fire label testing.
 - Provide extended lip strikes where required to protect frame or trim. Lip shall not extend more than 1/8" beyond frame or door (at pairs) or trim.
 - In renovation applications, comply with these requirements regardless of the style of existing locks and latches unless directed otherwise by Project Manager.
 - Door hardware and handles shall comply with all applicable code and accessibility requirements for the project.
 - Provide latch protectors at ALL exterior out swinging doors and at any interior locked, out swinging doors that require additional security.
 - Where both Mortise Type and Cylindrical locks are used in the same project care shall be taken to assure levers align when installed. Projects in existing construction shall require field verification of existing lever locations and care taken to match existing height on new installations.
 - Provide wrought boxes at strikes at wood frames or pairs of wood doors.
- Keypad Locks;
 - For keypad lock, Alarm Lock Trilogy DL4100. PCC will program. Please refer to PCC Lock Shop.
 - Padlocks;
 - Padlocks shall be provided and keyed by the PCC Lock Shop, where required.
 - Cylinders and Keying;

- Specify that all locks and latches be shipped without permanent cylinders. If required by the Contractor for temporary access, security and installation fit up, cylinders shall be provided by the Contractor at their own expense.
- The College will install all permanent cylinders and perform all keying.
- Installation of cylinders shall be coordinated with the PCC Lock Shop in advance of the installation date,
- Interchangeable or removable core cylinders are not employed by the College system and are not acceptable.

- Exit Devices;
 - Pre-qualified manufacturers are:
 - Von Duprin 98 or 99 series, 98-F or 99-F at Rated Openings, 33 or 35 33-F or 35-F for narrow stile. OWNER'S STANDARD, Device shall accept non-interchangeable core ASSA cylinders only. Permanent cylinders will be provided by PCC Lock Shop
 - Use the following functions and trim in the noted applications; use no other functions or trim. Thumb turn dogging preferred.
 - All locking applications: Von Duprin 99TP (thumb turn dogging). PCC will disable dogging after install if appropriate.
 - Use only rim devices. Size push pad portion of device to meet code requirements for Fire & Life Safety.
 - Do not use exposed or concealed vertical rod devices. Must have approval of the PCC Planning, Design and Construction Project Manager where other options are not practical.
 - All exit devices must comply with applicable code and accessibility standards & requirements for the project.
 - At "Night Latch" function doors use anti-vandal type pull trim at exterior applications where needed.
 - Provide "Less Dogging" where no dogging is desired. No manual dogging allowed at rated openings. Electrified Latch Retraction devices must be tied into the life safety alarm system and release/latch upon alarm.
 - Removable mullions are to be the screwed type, Von Duprin KR Series as appropriate for the application. At fire rated openings, mullions are to be UL listed for fire, up to 3 hours.
 - At Exit Devices, provide temporary construction cylinders and cores to assure proper functioning at the time of installation.
 - At pairs of doors use only one pull handle on the exterior and mount device flush to the door (no gaps). This is to limit the ability to tie leaves together by either school or non-authorized personnel
 - Where Access Control is required, use the HES 9600 series strike or Von Duprin 6300 as the first option with exit devices on interior doors. Exterior doors require a pre-load capable strike such as HES 7000.
 - Where electric latch retraction is required, use the Von Duprin Quiet Latch Retraction (QEL) device
 - At fire rated doors use exit device manufacturer's electrified handled trim, 24VDC at new construction, verify voltage at existing buildings.

- Electrified Applications for access control;
 - The College preference is to use electric strikes in low or medium use applications. Use Von Duprin 6211 for mortise and cylindrical lockset applications on interior doors. Exterior doors require pre-load capable strike such as HES 7000 or where air pressure imbalance or door shrinking/expansion likely.
 - Use HES 9600 or Von Duprin 6300 for surface mount exit device applications on interior doors. Exterior doors require pre-load capable strike such as HES 7000 or where air pressure imbalance or door shrinking/expansion likely.
 - Extended lip strikes should be avoided. Resolve frame issues when installed in frames with surface applied trim or facings.
 - Where areas require quiet hardware operation, utilize the QEL exit devices, electrified mortise or cylindrical locksets.
 - At pairs of doors utilizing locksets or fire rated doors requiring 24/7 latching provide electrified locksets as listed in lockset section above.
 - REX switches are typically not integrated in the hardware. The College security vendor provides Motion REX.

- MAGNETIC LOCKS should only be used as a last resort, and only in location where Fail-Secure locks can be used without jeopardizing life safety.
- Door Closers;
 - Use only Rixson Series 27 floor closer, with top and intermediate pivots, at all public exterior doors. Do not specify non-hold open Suffix "A". Okay to specify with selective hold open Suffix "S". COLLEGE STANDARD. NO SUBSTITUTIONS without PCC Superintendent approval.
 - Use LCN 4040/4041 XP, full cover, overhead closers at all other applications. COLLEGE STANDARD.
 - Take advantage of available arm options where appropriate for various situations. (Hold open, cushion stop, 180 degree, delayed action, etc.)
 - Extra duty arms at reverse bevel doors.
 - SCush arms at reverse bevel doors where floor stops may create a tripping hazard.
 - Provide necessary spacers, brackets, drop plates or accessories to avoid mounting conflicts with overhead stops, seals or other hardware.
 - Provide Closers at all classroom doors.
 - Require through-bolt installation at wood and non-reinforced metal doors and surface-applied installation at metal doorframes. Preferred installation is on the door. If jamb mounting is necessary, all holes to be drilled and tapped. See Section 08 11 00 for preparation and reinforcing of metal doors and frames.
 - 30-year warranty.
 - All closers must comply with ADA requirements. Door closers shall be adjusted so that from an open position of 90 degrees, the time required to move the door to an open position of 12 degrees shall be 5 seconds minimum. The force for pulling or pushing open interior hinged doors shall be 5.0 pounds maximum. Exception: Fire Doors shall have the minimum opening force allowable by appropriate administrative authority.
 - Use only wall-mounted hold open devices where doors with closers are intended to be normally open. Coordinate with Division 16 or 26, Electrical.
- Specialty Hardware;
 - Glass Doors: Use only standard and readily available hardware elements that accept standard PCC ASSA cylinders. Secure approval of PCC Lock Shop for all glass door and hardware applications.
 - All specialty hardware must accept COLLEGE STANDARD ASSA cylinders.
 - Locking cabinets: Preferred installation of Cam Locksets. PCC Lock Shop will provide the lock unless otherwise specified.
- Miscellaneous Hardware;
 - Specify all required miscellaneous hardware, including:
 - Stops (wall-type are preferred. Blocking must be coordinated, in walls, with other spec sections)
 - Kick plates on heavy traffic doors (classrooms, conference rooms, laboratories, etc.) and all wood doors with closers. Protective plates shall be a minimum of .050" thick, Beveled 4 sides and provided/installed with manufacturers standard countersunk screws. Kick plates shall be 1" Less Door Width (LDW) at pairs without mullions and 2" LDW at singles and pairs with mullions. Mop Plates shall be 1" LDW. Where armor plates are required to protect fire rated doors, they shall carry an engraved UL label.
 - Thresholds, door bottoms, and weather stripping on all exterior doors.
 - Interior smoke and door seals surface mounted or adhesive backed. Provide frame mounted intumescent seals only where required by the door manufacturers label requirements for each opening.
 - Knox Box: Coordinate with PCC Environmental Health and Safety for proper selection of and location of Knox Box. Recess where possible.

- Double Doors;
 - Refer to Section 08 00 00 for additional information.
 - Do not use vertical rod exit devices. Use removable mullions in most instances and only when required for additional opening either width or where the “door bank” principle cannot be applied. PCC prior approval is required.
 - At pairs of doors, where the inactive leaf is not required for egress, the use of surface bolts is preferred, with no door knob/lever or other hardware that would indicate this leaf is to be used for exiting. Mortised flush bolts are not to be used. Where self-latching or automatic bolts are required by code at fire rated openings this is to be reviewed with PCC Environmental Health and Safety for final approval. Use dust-proof strikes equivalent to Ives DP-2 where required to go into floor.
 - Where surface bolts are used, they should be Ives SB360 or equal.
 - Avoid use of automatic flush bolts, except as required by code or local Authority Having Jurisdiction.
 - Avoid use of coordinators; where unavoidable, use full width units, with closer brackets, in lieu of gravity arm.
 - Where required, use only T-type astragals, provide 7/8' flat lip strike, do not notch around the strike.
- Finish;
 - BHMA 626/652 (US 26D), satin chrome plate, uncoated
 - BHMA 630 (US 32D), satin stainless steel, uncoated
- Hardware Schedule;
 - Include a specific hardware group schedule, with group designations to be used on the drawings.

Part 3 - Execution

- Coordinate with other trades (Division 6 and Division 9) location of backing required for surface applied hardware. Review finishes and floor coverings for affect to door hardware or undercuts.
- Make sure that installation is specifically described, here or in the appropriate Division 06 section.
- Install all fire door hardware to comply with the requirements of NFPA-80-2007, Chapter 5.
- Coordinate sealing of exterior thresholds and rain drips with Division 07 – Thermal and Moisture Protection.
- Coordinate Electrified Hardware with Division 26 – Electrical and Tab B-3 – Keyless Access and Security. Other affected trades for getting and installing power, j-boxes, wiring, conduit, connectors and connections to the opening or hardware whether through the walls, concrete slabs, etc. shall be coordinated in the appropriate specification sections. Division of labor and materials of final electrified assembly by affected trades, for proper functionality shall be clearly defined.
- Require that all hardware including temporary test cylinders be installed, and all doors tested and adjusted for proper operation, prior to Substantial Completion.
- All door closers shall be readjusted after the air balance is complete.
- Latches shall be centered in strikes, i.e. filing of strikes is strictly prohibited.

- Demolition: All door hardware, including cylinders and cores, that are removed from existing openings shall remain the property of the College and shall be turned over to the PCC Lock Shop in an orderly fashion. Lock and Door Hardware removals shall be coordinated with the PCC Lock Shop Supervisor.

End of Section 08 70 00

DIVISION 08 - OPENINGS

Section 08 71 13 - Automatic Door Operators

Introduction

Pima Community College has determined that, based on its experience with the performance and durability of the products described in this Section, and based on the benefits of limiting the range of repair parts, which must be maintained in inventory, a proprietary specification is in the best interest of the College.

Require automatic door operators on at least one door leaf at each entrance intended or expected to be available for general ingress/egress use. Automatic door operator locations will be approved by Pima Community College. Use sliding automatic door operators only with the specific permission of the PCC Facilities Project Manager. Do not use the following products:

- Motion detectors
- Pressure mats

Coordinate electrical requirements on the drawings.

Part 1 - General

- Require that the supplier(s) and installer(s) demonstrate 5 years of successful installations of similar systems.

Part 2 - Products

- Approved manufacturer and models are:
 - Horton Series 4000 (heavy duty) for exterior doors and interior doors greater than 3'-0".

Generally, specify the following features:

- Electro-mechanical, swing operation
 - Sealed transmission
 - All metal gears
 - Interior, push side, surface, top jamb, mounting
 - Key controlled power shut-off
 - 3-second "door stalled" safety feature
 - Automatic assist on manual operation
 - Remote battery operated radio frequency, square push plate control, wall mounted, 2 for each door
 - Power on/off switch accessible on surface of operator.
-
- Safety rails are required but need not necessarily be the door operator manufacturer's standard products. Rails may be specified to harmonize with the overall building design.

Part 3 - Execution

- Refer to the Tab B-7 - Campus Accessibility for placement of automatic door openers.

End of Section 08 71 13

DIVISION 08 - OPENINGS

Section 08 80 00 - Glazing

Introduction

Glass is a major maintenance issue for the College due to breakage from accidents and vandalism. The Consultant is encouraged to use light sizes, which are easily replaced by the College, and carefully consider the use of any specialty glazing.

Part 1 – General

- Provide calculations for thermal stress, wind load, and structural requirements. Calculations for thermal stress should relate to partial, full and seasonal shading effects.
- Avoid the use of film applied to exposed surfaces of glass whenever possible.
- Tinted/colored glass or spectrally selective glazing shall be reviewed and approved by the PCC Project Manager.

Part 2 - Products

- Exterior Window Openings
 - Standard Glazing: 1" insulating units with solar control low emissivity (low-e) coating
 - Use heat-treated glass as required by thermal stress analysis
 - Use laminated glass for obscure or translucent glazing
 - Safety Glazing: 1" insulating glass units, where required by code, either fully tempered (FT) or laminated
 - Spandrel Glass
 - Use heat-treated glass as required.
 - Space immediately behind Spandrel glass shall be adequately vented.
- Interior Window Openings
 - Standard Glazing: Annealed float or laminated
 - Use laminated glass for obscure or translucent glazing
 - Safety Glazing: where required by code, either fully tempered (FT) or laminated
- Fire-rated Glazing
 - Due to high cost of installation and replacement, the use of fire rated glazing should be carefully considered during the design and approved by the PCC Project Manager.
 - Transparent ceramic (used as part of an insulating unit if exterior rated glazing is required).
 - Transparent wall units designed as a barrier wall (inert material turns to foam during a fire).
- Specialty Glazing
 - Coordinate approval of specialty glazing such as bullet resistant, acoustical, one way viewing, projection booths, etc. with PCC Project Manager to determine products that will meet specific needs.
 - Ceramic pattern may be used if reviewed and approved by PCC Project Manager.
- Mirror Glass: shall be framed in stainless steel or chrome and shall have a backing sheet.

Part 3 - Execution

- Mirrors shall be set with theft-proof mounting.

End of Section 08 80 00

DIVISION 09 - FINISHES

Section 09 00 00 - General Discussion

Introduction

Next to thermal and moisture protection, finishes are most critical to the projects' appearance over the long term. College facilities must have a useful life of forty to fifty years. Over this period of time there will be many changes and alterations to the building. Many user groups will occupy the facility and many students will pass through its doors. What the building will look like after a short or long period of time will be reflected in the selection of finishes and the ease of maintenance that can be provided by College staff. Also important in the appearance of the building will be the convenience and the availability of storage space for janitorial equipment and access to convenient janitor closets. These closets should be well thought out in the initial design and not become after thoughts randomly located. They should also not become the arbitrary repositories for miscellaneous items that were not considered in early design stages (i.e.: water heaters, terminal boards, mail cart storage, etc.).

- Excessively light or dark colored finishes should be avoided (especially black). Both are difficult to maintain.
- Ceramic tile should be applied to wall areas adjacent to drinking fountains or areas where water might splash and cause staining or deterioration of wall surfaces.
- Carpet should of a pattern, color or texture, which will provide for wear and soil hiding characteristics. Buildings on the campus generally have the carpet cleaned annually. Funding for more frequent cleaning is not available.
- Appropriate materials should be considered for high traffic areas and mats or grilles should be placed at entries to facilities.
- Equally important are impervious floor covering materials at potentially wet areas such as toilet rooms, drinking fountains and adjacent to sinks in work areas and even conference rooms where coffee may be served (and spilled).
- Smooth wall surfaces are to be avoided. Patches and blemishes will show.
- Protection of walls and corners shall be provided in areas where carts or other items might damage wall surfaces. A wood base or chair rail may be appropriate in heavy-duty areas.
- Marble is an absorbent material, which stains easily and is difficult to clean. It should be applied to vertical surfaces only.
- Shiny, mirror like surfaces should be avoided, especially where touching is possible. These surfaces require additional maintenance and may not be maintained in the condition the designer intended.
- For flooring applications on concrete slabs on grade special precautions are typically necessary to alleviate the concerns for vapor transmission. Refer to Section 03 33 00 – Architectural Concrete.
- To alleviate flooring material concerns associated with moisture transmission and emission through concrete slabs on grade the following preventive measures shall be prescribed.
 - An under slab vapor barrier should be specified and detailed directly under the concrete slab and on top of any subgrade or sand grading material to minimize moisture transmission through the slab. Vapor barrier shall meet the requirements ASTM E-1745 Class "C". Acceptable vapor barriers are "Stego Wrap" by Stego Industries and "Moistop Plus" by Forfiber Building Products Systems.

- A low water to cement ratio, low slump concrete should be specified for all interior slabs where flooring is anticipated to minimize the amount of free water in the concrete. Sufficient time should be allowed with the project to allow any free moisture to evaporate from the slab.
 - Surface sealers may be considered for re-flooring applications on existing slabs.
- There are several types of exposed concrete floor finishes to be evaluated and considered during the design process and they are identified below. Once the design/construction team has determined which ones will be incorporated, a meeting should be scheduled to review with PCC Custodial and any specialty subcontractors to guarantee compatibility of all materials and methods of maintenance.
 - Mechanical Rooms: These are not maintained by PCC Custodial and should be cured and sealed by the contractor. Products such as Super Aqua-Cure Vox, a high solids, water-based cure and seal, have been utilized in the past. Contractor should protect the floors during construction and clean and apply an additional coat of sealer before Substantial Completion.
 - Custodial Closets and Classroom floors (if exposed plain concrete): These will be maintained by PCC Custodial. Any cure and seal product needs to be compatible with Johnson Wax Carefree and High Mileage products. Contractor should protect the floors during construction and provide a clean floor upon Substantial Completion for final finishing by PCC prior to occupancy.
 - Polished Concrete floors in high use public areas: Densified, ground, and polished concrete floors are being used more often on campus due to their appearance, durability, and reduced maintenance costs. The design/construction team should vet successful systems and requirements with local specialty subcontractors.
 - The application of curing compounds and sealers can have a cosmetic effect on exposed concrete. A thin and even application by a trained professional is required.
 - Alkali-Silica Reaction (ASR) is a concern on exposed concrete floors. Consideration should be taken to add 18-20% fly ash and shrinkage compensating add mixtures to the concrete mix.

Common sense should prevail in the selection of materials and consideration given to the fact that the College is a public facility used by thousands of people daily. Maintenance budgets are minimal and design elements, which create hardships, will not be attended to. This challenge can still foster creative ideas to resolve the design problem.

End of Section 09 00 00

DIVISION 09 - FINISHES

Section 09 20 00 – Plaster and Gypsum Board

Introduction

Coordinate this Section closely with Section 09 22 16 – Non-Structural Metal Framing and other sections to which plaster and/or “stucco” may be applied.

Lath and plaster installations shall be detailed on the drawings, to the extent not sufficiently established by industry standards and to avoid misunderstandings. Pay particular attention to substrates, intersections, joints, expansion and contraction.

Avoid integral color plaster due to inconsistencies of color mixing. Apply plaster in standard gray color and finish with paint to seal and provide desired color.

Part 1 - General

- Lath and plaster work shall be in accordance with the recommendations of the following:
 - “Portland Cement Plaster (Stucco) Manual” published by the Portland Cement Association.
 - “Specifications for Metal Lathing and Furring” published by the Metal Lath/Steel Framing Association, a division of the NAAMM.
 - “Plaster/Metal Framing Systems/Lath Manual” distributed by the Plastering Information Bureau of California.
- On major new projects, require a field constructed mock-up for verification of texture, assembly, and details. The mockup shall be maintained at the job site until the end of the project.
- Generally, remodeled plastered areas shall be plasterboard with plaster finish coats as required and new plastered walls shall be the Imperial plasterboard base with Imperial plaster finish or EFIS.

Part 2 - Products

- Expanded metal lath shall be self-furring, 3.4 lbs /sq yd., diamond mesh, galvanized steel sheet for exterior use and wet interior areas.
- Plaster on masonry shall be two-coat type work and on wood or steel framing shall be three coat type work. Mix design shall be verified before plastering operations begin and shall include alkaline resistant glass or polypropylene fiber reinforcement strands.
- Plaster accessories shall be metal. Small-nose corner beads shall be fabricated of zinc alloy and have expanded flanges of large mesh diamond lath for plaster embedment. Casing beads shall be square-edge type.
- Expansion joints shall be one-piece type in “M” shaped configuration, with expanded metal flanges, except 2- piece type may be used where expansion exceeds the one piece capabilities.

Part 3 - Execution

- Provide for expansion in exterior and interior plaster installations. Locate expansion joints where recommended by standards, but not more than ten feet on center nor defining panels greater than 100 square feet. Re-entrant corners shall have expansion joints provided.

- Moist cure Portland cement plaster in accordance with the requirement of ASTM C926, including “Annex A2 Design Considerations”

End of Section 09 20 00

DIVISION 09 - FINISHES

Section 09 22 16 – Non-Structural Metal Framing

Introduction

This section refers to light gauge metal framing and should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Where not otherwise required by code and so to achieve greatest flexibility and cost efficiencies, non-bearing interior partitions shall be uninsulated, both sides fully sheathed, textured and painted full height terminating at the top plate 6" above ceiling, and laterally braced to structure above. Exceptions to this basic design standard requires that the Design Professional at the onset of the Schematic Design phase estimate the added cost of all interior partitions having thermal or acoustical insulation and/or extending partitions above ceilings to underside of structural deck. The project manager requires approval for such exceptions.

In areas where partitions are subject to severe impact loads, and in situations where fixtures and appurtenances are intended to be supported directly from partitions, require the installation of backing and/or blocking in the partitions, according to the following criteria. Describe the locations for all backing and blocking on the drawings. Considerations for blocking are as follows:

Specify appropriate size/gauge of metal backing for support of heavy wall hung fixtures, handrails, etc., with a minimum load resistance capacity of 200 lbs. in any direction.

3-1/2" blocking at the bottom of heavy duty partitions where resilient floors are scheduled to be installed (to protect wall from floor cleaning equipment impacts)

Provide blocking at points of attachment for small fixtures, toilet accessories and partitions, handrails, doorstops, etc. Blocking shall be 2x6 minimum fire retardant treated wood blocking or 6" wide 20 gauge (sheet metal gauge) galvanized sheet metal with a minimum wall thickness of 0.0356" (0.0400" nominal).

Coordinate this Section closely with Section 09 20 00 - Plaster and Gypsum Board and Section 09 29 00 - Gypsum Board.

Part 1 - General

- These standards shall be applicable unless the partition or wall is specifically designed otherwise.
- All cold formed steel shall comply with Steel Stud Manufacturers Association (SSMA) and American Iron and Steel Institute (AISI).

Part 2 – Products

- Prescribe all studs to be minimum 20 gauge (steel stud gauge) with minimum wall thickness of 0.0300" (30 mls). Locate all studs at 16" OC.

Part 3 - Execution

- Require that all metal support systems attached to the structure above (including floor tracks, ceiling tracks, and perimeter wall studs) be installed using only drilled anchors. Powder driven fasteners are allowed if installed with minimum 1" long shot pins (.145 shank size) are used with the correct load.

- Specify neoprene gaskets under runner tracks and perimeter studs at acoustical-rated partitions. Floor runner tracks (and some ceiling tracks) to be set in a bead of caulking.
- Specify framing intersections and special conditions as follows:
 - Three studs or floating stud at all corners
 - Double 20 gauge studs at door jambs, and each side of openings & end of wall terminations
 - Double studs both sides of expansion joints
 - Specify slip track at ceiling conditions where deflection is anticipated.
 - Provide double studs at all door openings with studs secured together on both sides.
 - Provide intermediate bracing placed at 6' OC vertically where walls exceed 12' in height. Provide minimum
 - ¾" cold rolled channel bridging with clips at each stud.
 - Specify blocking and attachment devices to be provided where shelves or casework are installed.
 - All walls enclosing plumbing waste or vent lines to be appropriately sized to accommodate plumbing lines and/or 6" minimum in depth unless a chase is provided.

End of Section 09 22 16

DIVISION 09 - FINISHES

Section 09 29 00 - Gypsum Board

Introduction

This is a section where the consultant should use a "performance specification". Do not specify proprietary manufacturer's names or materials, and do not restrict vendors to a limited list.

Mechanically fastened paperless sheathing panels made of water resistant and silicone treated cores surfaced with glass mat facings with alkali-resistant coating (comparable to Dens Glass Gold Sheathing) may be specified for wall and soffit substrate construction at above grade exterior and at interior wet locations, excluding locations where tile/brick/stone clad finishes are specified. Specify Portland cement glass mesh board or lath and plaster for walls and soffits where tile, brick, and stone finishes are specified.

Describe locations for all expansion joints in gypsum board walls and ceilings on the drawings. Coordinate this Section closely with Section 09 22 16 - Non-Structural Metal Framing.

Part 1 - General

- Identify as reference standard the criteria of the following organizations:
 - The Gypsum Association
 - The United States Gypsum Company (the non-proprietary aspects of the Gypsum Construction Handbook)
- Do not interrupt gypsum board at fire resistant partitions for blocking, ceramic tile backer boards, or other construction.

Part 2 - Products

- Require use of 5/8" gypsum board panels throughout. Allow use of 1/2" panels only in concealed conditions such as pipe chases and air plenums (subject to fire-resistant requirements).
- Specifically call for use of fire-resistant, moisture-resistant, and combination fire-and moisture-resistant panels, where required.
- Specify mold resistant and paperless board in all wet locations, which shall comply with ASTM C1178/C and 1178M.
- Secure panels to framing 8 inches on center at edges and 12 inches on center within field.
- Require use of maximum practicable panel lengths to reduce number of joints.
- Specify only metal trim, joints, and accessories, designed for mechanical attachment.
- Require that all gypsum wallboard receive PVA primer prior to texture. Do not confuse this gypsum board primer with painting primer.

Part 3 - Execution

- Specify only screw attachment for gypsum panels to both wood and metal framing, and for all trim, joints, and accessories.

- Specify corrosion resistant screws in all wet locations.
- Require that vertical joints be staggered 1/2 panel.
- Require that gypsum panels be installed continuous over openings, and extend at least 1 full stud beyond the opening edge.
- Specify "floating stud" and "floating corner" installation techniques.
- Specifically describe requirements for installation and spacing of expansion joints in walls and ceilings.
- Specify finish textures for interior spaces as follows:
 - PVA gypsum board primer. Light skip trowel to match the Owner's sample in new areas such as offices, corridors, classrooms, conference rooms, libraries, etc.
 - Light stipple in wet or sanitary areas.
 - Smooth finish, if necessary, shall be specified in Section 09 20 00 – Plaster and Gypsum Board.
 - Match existing surface textures in areas where existing walls are retained.

End of Section 09 29 00

DIVISION 09 - FINISHES

Section 09 33 00 – Conductive Tiling

Introduction

Tile work shall be designed and specified in accordance with the current edition of the Tile Council of North America (TCNA) Handbook for Ceramic Tile Installation and The American National Standards Institute (ANSI) for the materials used to install and grout ceramic tile and stone.

Indicate extent and any patterns of tile work on the drawings, including floor and wall layouts, full height or wainscot limits, tile sizes, color arrangement, perimeter conditions, interface with dissimilar materials, trim components, control and expansion joints, thresholds and setting details.

Multiple stall restrooms: indicate on drawings, full height tile (from floor to finished ceiling) at wet walls behind toilets and at side return walls at toilets, to ensure wall tile is behind all accessories such as toilet partition brackets and grab bars. Indicate full height tile behind wall hung sinks; tile above vanity counter surface to ceiling (full tile behind mirrors).

A variety of tile types may be used in combination (glass, matte, gloss). During the design phase, prepare a Color Board “mock up” using full size tiles to clearly demonstrate the design intent of the finished installation. Present patterns, sizes, finishes and colors using actual tiles for user group review and approval.

Trim and Accessories: Verify that matching tile trim units are available for the specified floor and wall tile. Availability: In the event matching tile trim is not manufactured, specify and detail metal or rigid PVC trim components (products such as Schluter-DILEX-HK®, or similar) for sanitary cove base, inside and outside corners, unfinished tile edges and floor change transitions in lieu of sealant and caulk to treat such transitions.

Retrofit of existing showers, as well as new installations, which provide handicapped access to showers shall be carefully studied and floor slopes, floor drain locations and waterproofing shall be carefully analyzed and detailed. Provide details for setting beds, expansion and control joints, waterproofing, and drain seals.

Linear Floor Drains (stainless steel) preferred for ganged showers.

Preferred tile sizes for shower room floors are porcelain 1” x 1” or 2” x 2” maximum and shall meet ≥ 0.42 requirement, measured per the DCOF AcuTest®, for level interior tiles that will be walked on when wet. Pre-Installation Meeting: At least three weeks prior to commencing tile work, contractor to conduct a meeting at the project site with tile installers, architect and PD+C project manager to discuss job conditions and scope.

Part 1 – General- Considerations for Selection

- When patching tile in existing areas, develop a pattern rather than merely replacing required tile (when owner replacement stock is depleted and the original tile is no longer available or discontinued).
- Dark grout colors are preferred in areas that are routinely exposed to wet mops (floor tile, wall base).
- Polished and semi polished surfaces create a very smooth surface and are not recommended for flooring applications in areas exposed to water, oil, or grease.
- Interior public areas that are likely to be walked on when wet, shall meet ≥ 0.42 requirement, measured per the DCOF AcuTest® (Wet)

- Exterior Applications exposed to water (pedestrian plazas, pool decks) shall meet ≥ 0.60 requirement, measured per the DCOF AcuTest® (Wet) when tile size is larger than 3x3.
- Glazed floor tiles and porcelain tiles on ramped surfaces shall meet ≥ 0.65 requirement, measured per the DCOF AcuTest® (Wet) when tile size is larger than 6x6.
- When specifying products for flooring applications, consider ease of maintenance for custodial cleaning staff. Select products that resist scratches and resist stains from soil, body oils, food and beverage spills, etc.
- Avoid caulked joint transitions at wall base as these areas deteriorate quickly when exposed to routine cleaning and must be continually maintained throughout the life of the installation.

Part 2 - Products

- Products shall meet or exceed the specified requirements of ANSI A137.1, for types, compositions and other characteristics indicated.
- Single Source Responsibility: For quality assurance, obtain each type and color of tile from a single source. Obtain each type and color of mortar, adhesive and grout from the same source.
- Products shall be suitable for a Commercial environment and for the specific usability needs of the application. Verify ASTM Porcelain/Ceramic test results for Water Absorption (ASTM C73-88) Scratch Hardness (MOHS scale rating) Breaking Strength (ASTM 648-04) Chemical Resistance (ASTM C650-04) and Abrasion Resistance (ASTM C1027-99).
- Ceramic or Porcelain tile used on floors to have MOH's Scale Hardness Value of 7 or greater and an Abrasion Resistance Classification of Class Four (4) or greater, per ASTM C1027-99.
- Non-Ceramic Trim: satin anodized aluminum or stainless steel finish with profile that is suitable for the application at open edges of tile. Detail exposed edge protection and transition profiles at floors and corners, including but not limited to: transitions between floor finishes of different heights, between tile surface and adjoining finishes at doorways, and expansion and control joints at floors and walls.
- Stone Thresholds shall be uniform in color and finish. Marble complying with ASTM C241 for abrasion resistance and ASTM C503 for exterior use; Granite complying with ASTM C 615.
- Showers: Specify acrylic coated mold and moisture resistant gypsum panel substrate for inside shower areas. Install in accordance with TCNA Handbook Methods. Products shall comply with ASTM C1178/C, 1178M and ASTM D3273 (Products such as National Gypsum Gold Bond eXP® Tile Backer, Georgia Pacific DensShield® Tile Backer, Certainteed M2Tech® Moisture & Mold Resistant Gypsum Board, or similar).
- Specify and detail Waterproofing Membranes for shower walls and bases, pipe protrusions, inside and outside corners, curbs and wet area shower niches. (Composite sheet membrane products such as NobleSeal TS® or similar. Liquid applied waterproofing membranes products such as Laticrete Hydro Ban®, Laticrete 9235®, RedGard®, or similar).
- Wet areas: Specify moisture resistant board as a tile backer in toilet/sink areas with limited water exposure. (Products such as National Gypsum eXP® Gypsum Board, or similar).
- Silicone sealant, moisture and mildew resistant type for shower floors and shower walls.
- Quarry or treaded paver products with matching cove base and epoxy grout is recommended for flooring in Service or Food Prep areas accumulating oils, grease and water.

- Textured or Small format tile is preferred in wet areas such as kitchens, showers, and exterior areas where rain may mix with dust and make a slick surface.

Part 3 - Execution

- Installation shall be in accordance with Tile Council of America Standards (TNCA) and shall adhere to industry installation guidelines ANSI A108, A118 and A136.
- Specify the setting method for each type tile and location by reference to TCNA standards. Generally, all tile installations shall be thin set except sloped floors and shower floors where mud set shall be used.
- Setting materials, grouts and sealants shall be appropriate for the installation method.
- Coordinate and detail expansion joints with building details. Ensure tile joints are watertight, without voids, cracks, excess mortar, or excess grout. Contractor to apply penetrating sealant (colorless, stain-resistant sealer, not affecting color and physical properties of ceramic tile and stone surfaces). Protect finished installation until substantial completion acceptance.
- Extra stock for the Owner's use in replacement and maintenance shall be clearly labeled and consist of one box or at minimum, 2 percent of each of the primary sizes and colors of tile installed as well as extra stock of adhesives, mortars, grouts and other installation materials from same production run or batch as original tile and installation materials.
- Require submission of an "as-built" color and material schedule with the project closeout documents, including:
 - Descriptive location (room number, etc.)
 - Tile (manufacturer, color and size)
 - Grout (manufacturer and color)

End of Section 09 33 00

DIVISION 09 - FINISHES

Section 09 51 00 - Acoustical Ceiling

Introduction

The selection and specification of acoustic ceiling systems should be based on a careful analysis of functional, aesthetic, and cost criteria. Fire resistance, sound absorption, noise reduction, durability, and appearance considerations will combine to narrow selection choices to a range of a few acceptable alternatives, so that cost may serve as a final determinant to list of two or three acceptable products for bid.

Ideally, the specification should be performance-based, but it is in the College's best interest in acoustical ceilings to inform bidders through semi-proprietary specifications, which describe essential characteristics and name a selection of 3 or more products by different manufacturers which the Consultant has determined meet the functional and aesthetic requirements.

Acoustic ceiling material specifications should list required type, form, pattern, and noise reduction coefficient or articulation class, ceiling sound transmission class, light reduction coefficient, flame spread, fire resistance classification, and sanitation. On projects with unique requirements, such as performing theater or auditorium, a special acoustic consultant should be considered to advise the Consultant in the design of the space as well as the acoustic materials of the spaces.

Part 1 - General

- Where not otherwise required by code and so to achieve greatest flexibility and cost efficiencies, non-bearing interior partitions shall be uninsulated, both sides fully sheathed, textured and painted full height terminating at the top plate 6" above ceiling, and laterally braced to structure above. Exceptions to this basic design standard requires that the Design Professional at the onset of the Schematic Design phase estimate the added cost of all interior partitions having thermal or acoustical insulation and/or extending partitions above ceilings to underside of structural deck. The project manager requires approval for such exceptions.
- Ceilings in general areas (offices, corridors, public spaces) should generally be 2' x 4' square-edged lay-in panels.
- Ceilings utilizing special lay in panels, different sized grids such as a 2 X 2 grid, and/or enhanced acoustical ceiling tile may also be considered if the Project Manager approves the special use and added cost at the onset of the Schematic Design phase.
- Entry lobbies and conference rooms may use tile and grids with more design-oriented features.

Part 2 - Products

- Specify color/light reflectance values and noise reduction coefficients of materials specific to project's individual space requirement needs and to achieve an appropriate design versus cost balance. The following industry standard technical characteristics should be discussed with the project manager as an initial basis of design.

Color/Light Reflectance	White/LR not less than 0.75
Noise Reduction Coefficient	NRC not less than 0.70
Ceiling Attenuation Class	CAC not less than 35

- Grid shall be heavy duty or intermediate

Part 3 - Execution

- Grid
 - Following texturing and painting wall, screw grid to studs-stapling of grid to wall is not allowed.
 - Tie tracks and grid tightly to allow easy tile removal.
 - Wires shall not be kinked and tails shall be cut.
 - Do not hang from nonstructural elements.
 - Seismic bracing is not required.
 - Powder driven fasteners are allowed if installed correctly, i.e., proper load and pin length. Otherwise, drilled anchors shall be used.
 - Provide separate wires for hanging light fixtures.
 - Dimension cuts and borders. Control the grid layout with dimensions; do not rely on a “balanced” layout.
- Trapezes shall be installed where interference’s are encountered during the installation.
- Remodel or renovation projects may require that the existing grid be painted. Do not paint the existing tile and reuse it. Provide new tile.
- Provide a detailed materials list with manufacturers name, lot number, stock number, name, color, etc. An extra stock of material shall be provided.

End of Section 09 51 00

DIVISION 09 – FINISHES

Section 09 65 00 – Resilient Flooring

Summary

This section includes, resilient tile flooring, resilient base and accessories, resilient stair treads, risers and landings.

Introduction

Consider project areas where resilient flooring is appropriate for increased durability, ease of maintenance, ease of replacement and impermeability to liquids. These areas include but are not limited to; high traffic public corridors, breakrooms, flooring areas adjacent to countertop sink /food and beverages, elevator floors, retail sales floors, resident life facilities or areas where inlaid custom logos or wayfinding is a desired design feature.

Product selections should take advantage of sustainable options as much as possible. Consider manufacturers who practice environmental responsibility through programs of source reduction, recycling, reuse, and conservation. Considerations for sustainability and recyclability of products include; certified Low Emitting products and adhesives, Indoor Air Quality FloorScore certified products, products with Pre-Consumer Recycled Content, products and adhesives certified to meet LEED IEQ Low Emitting Interiors and Green Label Plus #GLP08020.

Specify products with cushion backing where Acoustic properties are required.

Require pre-installation meeting to verify project requirements and substrate conditions.

Require Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.

Part 1 – General

- During the Design Phase, present full size product selection samples to the User Group for pre-approval of finish colors, patterns and textures.
- Include flooring type, color and any special layout provisions (borders, transitions etc.) in the construction documents. Provide a Finish floor plan to indicate pattern type(s), location, tile (plank) direction and installation method.
- Specify product numbers and colors for resilient base and accessories. Detail transition(s) to other flooring materials. For renovation projects, consider matching the existing, building standard product and color for continuity and ease of maintenance replacement. In large classrooms i.e. auditorium or tiered classrooms, detail flooring transition strips at tiers, aisles and stair nosing. Require high performance epoxy adhesive for installation longevity.
- Require that manufacturer(s) and installer(s) demonstrate at least 5 years' successful performance with similar commercial resilient flooring installations.
- Require submission of manufacturer's technical literature for specified products, describing physical and performance characteristics, size/pattern/colors, test reports, VOC content, and flame spread characteristics. ASTM F970 Static Load, ASTM F1914 Residual Indentation, ASTM F1515 Resistance to Light, ASTM F925 Chemical Resistance, ASTM D2047 Slip resistance, ADA Compliant.
- Require submission of an "as-built" color and material schedule for each product installed with the closeout documents, including Descriptive location, Manufacturer (pattern/name/number) and Color (name/number).

- Require submission of Manufacturer's Warranty and recommended maintenance and cleaning procedures to include precautions against cleaning materials and methods detrimental to finishes and performance.
- Require delivery to the Owner /FM of maintenance stock, from the same manufactured lot as materials installed. Furnish 120 LF (one carton) for each color and type of wall base installed. Furnish 3% of the total square footage of the major field color of the flooring installed. Furnish one full carton for each accent color or border pattern installed. Package in protective covering with labels clearly describing the contents and installation locations. Include the following wording with the maintenance stock specification - "It is unacceptable to consider this maintenance stock for standard installation overages. This is "attic stock" to arrive on site cleanly wrapped and labeled as "attic stock" for the owner to use for future repair and maintenance. It is not considered as waste stock or overages that the contractor bids for installation purposes." Require legible Transmittal, clearly itemizing all products with descriptive name/numbers/colors and quantities that are delivered to FM. Verification and signature from FM is required to confirm the quantities received.
- Specify special warranty provisions as follows:
 - Two Year Installation Warranty: signed by the contractor and installer, agreeing to repair or replace defective materials and workmanship over a TWO year period from date of Substantial Completion.
 - 10 Year: Manufacturing Defects Warranty, Limited Commercial Wear Warranty and Underbed Warranty (No Dent). Product Warranties must be from the manufacturer, and must be offered as the manufacturer's warranty.

Part 2 - Products

- Resilient Wall base
 - Material: Rubber, Style B (cove - with toe), 4" high, ASTM F1861, Type TS (Rubber), Group 1 (solid, homogenous).
 - Cut lengths 48 inches preferred, or coils in manufacturer's standard length, per project requirements.
 - Job formed corners are preferred. Miter inside corners. At outside corners, "V" cut back base strip to 2/3 of its thickness and fold. Avoid specifying preformed corners, as they tend to come loose during routine cleaning operations and become an ongoing maintenance issue.
- Stair Covering
 - Material: Rubber, FS-RR-T-650, ASTM F 2169, Class I, Type TS (Rubber, vulcanized thermoset), Class 2 (Pattern, embossed, grooved or ribbed), Group 2 (Contrasting color for Visually Impaired). Stair risers and stair nosing (square): full length, height and depth in one piece. Landing Tile to match.
- Rubber Tile
 - Per project requirements Type 1 (homogenous rubber sheet flooring) or Type II (heterogeneous rubber sheet flooring); layered composition of 100% natural and synthetic rubbers) to meet the performance requirements of ASTM F1859, "Standard Specification for Rubber Sheet Floor Covering without backing".
- Vinyl Composition Tile
 - ASTM F 1066, "Standard Specification for Vinyl Composition Floor Tile", Class 2, Through Pattern, ISO 10595, Type II. Asbestos Free. Wear Layer thickness: 1/8 inch minimum.
- Resilient Linoleum Sheet Flooring

- (Homogeneous mixture, primarily of natural materials consisting of wood flour, limestone, color pigments, linseed oil and resin binders, mixed and calendared onto a jute backing). ASTM F 2034, Type I, "Standard Specification for Sheet Linoleum Floor Covering Without Backing". Colors and pattern detail shall be dispersed throughout the thickness of the wear layer. Provide integral flash cove wall base where hygienic base condition is a project requirement. Comply with ASTM 1516 for seamless installations (heat-welded seams).
- Solid Vinyl Floor Tile and Luxury Vinyl Plank
 - Commercial Grade, ASTM F 1700 "Standard Specifications for Solid Vinyl Tile", Class III. Type B, (embossed surface) - per project requirements. Construction: layered product consisting of urethane wearlayer decorative printed film and backing with pre-and-post consumer content.
 - Wear Layer thickness – per project requirements. Min. 20 mil or 0.020 inch (0.51 mm) for office and light traffic areas. 30 mil (0.76mm) or higher wear layer is preferred for increased durability in high use corridors, retail and healthcare installations.
 - Edge: Square Edge Preferred for maintenance.

Part 2.1 – Installation Materials

- Trowelable Leveling and Patching Compounds: recommended by floor tile manufacturer for applications indicated.
- Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- Floor Polish: Provide protective, neutral pH liquid floor-polish products recommended by floor tile manufacturer.

Part 3 – Execution

- Require floor leveling and patching, for both new and renovation projects, in this Section.
- Lay out floor tiles from center marks established with principal walls, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile or plank at perimeter.
- Require that installation be accomplished in accordance with manufacturer's recommendations. Clean, seal and polish/wax floor and base surfaces in accordance with manufacturer's instructions.
- Require subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs. Require Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. Follow manufacturer's requirements for installation longevity.
- Describe requirements protecting installation until Substantial Completion in this section.

End of Section 09 65 00

DIVISION 09 – FINISHES

Section 09 68 00 – Carpeting

Introduction

Modular Carpet Tile is preferred over broadloom for ease of replacement.

Consider the project budget, intended use and future custodial maintenance when selecting carpet products. Carpet materials performance and installed cost shall address the needs for heavy traffic characteristics, likelihood and types of potential staining agents and required longevity of the installation.

Limit color choices to those that will provide substantial wear and soil hiding characteristics. Restrict solid colors to accent areas or borders. Avoid light colors that tend to show stains and soil. Color variation and random patterns are preferred to help blend new tile with existing when selectively replacing stained or damaged tile.

Avoid specifying custom carpet patterns or colorways. One hundred square yards' minimum is typically required for re-ordering custom carpet products. This is cost prohibitive for future renovation work where small areas of new carpet are integrated with and intended to match the existing carpet product. Attic stock quantity for use in replacing soiled and damaged carpet tile is limited. Facilities maintenance budgets cannot support ordering new custom carpet product after the attic stock is depleted.

Custodial maintenance includes regular vacuuming with heavy-duty equipment, periodic spot treatment to remove spills that do not get cleaned up immediately and annual carpet cleaning using hot water extraction.

Selection of carpet materials must adhere to all pertinent ADA requirements.

Selection of sustainable carpet options is encouraged. Consider manufacturers who practice environmental responsibility through programs of source reduction, recycling, reuse, and conservation. Manufacturer must provide Environmentally Preferred Product Declaration document listing ingredients of yarn and backing components.

Consider integrating areas of walk-off carpet tile at exterior entrances, vestibules and high traffic corridor areas to protect the carpet from soil and heavy wear. Match the profile (overall pile height) of the walk off carpet tile product with the field carpet tile to eliminate transition strips and/or to reduce compound underlayment at their interface.

Do not specify carpeted floor finishes in wet locations such as toilet rooms, wet laboratories, and other similar spaces. This includes small areas within larger spaces such as around coffee bars, drinking fountains, entry vestibules, etc. Walk-Off type carpet tile may be suitable in small areas on a project-by-project basis. Discuss with PCC Project Manager.

Where carpet is being installed directly over asbestos-containing resilient flooring ("encapsulation"), specify a releasable installation, using "peel-and-stick" materials or special adhesives. The College on a case-by-case basis decides encapsulation.

Part 1 – General

- During the Design Phase, present full size carpet tiles to the PCC Planning Department for design approval.
- Include carpet type, color and pattern selections, and any special layout provisions (borders, transitions etc.) in the construction documents. Provide a Finish floor plan to indicate pattern type(s), location, tile direction and installation method (monolithic, quarter turn, ashlar, brick pattern, interactive, etc.).
- Coordinate requirements for resilient base and accessories with Section 09 65 00 – Resilient Flooring.

- Specify product numbers and colors for resilient base and accessories. Detail transition(s) to other flooring materials. For renovation projects, consider matching the existing building standard for continuity and ease of maintenance replacement. In large classrooms i.e. auditorium or tiered classrooms, detail flooring transition strips at tiers, aisles and stair nosing. Require high performance epoxy adhesive for installation longevity.
- Require that manufacturer(s) and installer(s) demonstrate at least 5 years' successful performance with similar installations.
- Require submission of manufacturer's technical literature, test reports, VOC content, and flame spread characteristics.
- Require products have components manufactured by a single source. Fiber and backing, as well as final carpet product, should be manufactured and warranted by same company. Carpet of the same type, installed in a continuous area, to be from the same dye lot or a mergeable dye lot (replaced without visual recognition).
- Require submission of an "as-built" color and material schedule for each carpet installed, with the closeout documents, including Descriptive location, Manufacturer - Carpet type (pattern/name/number), Color style (name/number).
- Require submission of Manufacturer's Warranty and recommended maintenance cleaning procedures including stain removal products, instructions for hot water extraction method and precautions for cleaning materials and methods that could be detrimental to the carpet tile.
- Require delivery to the Owner/Facilities of maintenance stock, from the same product run that match products installed. Package in protective covering with labels clearly describing the contents and installation locations. For carpet tile, provide full size units, equal to 5% of the major field tile installed, and 10% for each accent tile installed. Include the following wording with the maintenance stock specification - "It is unacceptable to consider this maintenance stock for standard installation overages. This is "attic stock" to arrive on site cleanly wrapped and labeled as "attic stock" for the client to use for future repair and maintenance. It is not considered as waste stock or overages that the contractor bids for installation purposes." Require legible transmittal, clearly itemizing all products with descriptive name/numbers/colors and quantities that are delivered to Facilities. Verification and signature from Facilities is required to confirm the quantities received.
- Specify special warranty provisions as follows:
 - Two Year Installation Warranty: signed by the contractor and installer, agreeing to repair or replace defective materials and workmanship over a TWO year period from date of Substantial Completion.
 - 10-year, non-prorated manufacturer's warranty for failures including, but not limited to; no more than 10% face fiber loss, edge raveling, zippering, delamination, dimensional instability, loss of tuft bind strength, excessive static discharge, lack of colorfastness and where face fiber is 100% solution dyed, inability to remove acid based stains.
 - Chair pads must NOT be required to maintain the warranty.
 - Carpet must be manufactured and warranted by same manufacturer. Warranties must be from the carpet manufacturer, and must be offered as the manufacturer's warranty.

Part 2 - Products

- Specify High Traffic Commercial Carpet complying with these general criteria and performance characteristics.
 - Pile: Tufted Level Loop, Tufted Textured Loop or Tufted Cut & Loop.
 - Fiber: Branded; Type 6 or 6,6; Solution Dyed Nylon; minimum of 25% recycled content.
 - Minimum Surface Pile Weight: 15 oz./sq. yd.
 - Minimum Density: 5000 oz./cu. yd.

- Backing: non-woven primary backing with a high performance secondary backing system that contains recycled content. Consider the functional needs of the areas receiving carpet and the performance characteristics of the backing to enhance the longevity and durability of the carpet. Specify non-permeable backing for areas requiring added moisture protection.
- Indoor Air Quality: Green Label Plus #GLP08020 for carpet and adhesive products.

Part 3 - Execution

- Require floor leveling, for both new and renovation projects, in this Section.
- Require that installation be accomplished in accordance with manufacturer's recommendations.
- Adhesive system must adhere the carpet to the substrate and requires close attention around door jams, thresholds, corners and other areas where carpet tile edges tend to come loose. Glue down installation method to be accomplished in accordance with manufacturer's recommendations.
- Alternative installation systems such as TacTiles, Lokdots, etc., shall be discussed with the PCC Project Manager and User for an alternative to wet adhesive.
- Require testing of new concrete slabs for moisture and pH readings to ensure they are within the specified tolerance of the adhesive to be used.
- Describe requirements protecting installed carpet until Substantial Completion in this section.

End of Section 09 68 00

DIVISION 09 – FINISHES

Section 09 90 00 - Painting and Coating

Introduction

This section applies to exterior and interior areas or surfaces which are intended to receive a final field painted finish. Final painted finishes serve two primary purposes:

- Provide a satisfactory protective coating for the surface
- Provide an aesthetically pleasing finish

When contemplating a painted finish for a particular surface, consider that the surface must be realistically accessible for maintenance and repainting in the future.

For special coating and finishes applications which are not traditionally considered "painted finishes," such as gymnasium floor finishes, corrosion resistant finishes, concrete floor sealers, concrete and masonry wall sealers, traffic coating, tennis court surfacing, etc. verify with PCC Facilities Planning Department.

Include a paint or finish schedule on the drawings, listing colors, locations and types of materials.

Part 1 - General

Do not specify painting for:

- Prefinished items (e.g. toilet partitions, acoustical materials, light fixtures, finished mechanical/electrical/plumbing equipment in concealed areas, etc.)
- Finished material surfaces (e.g. anodized aluminum, stainless steel, chromium plate, copper, plated hardware, rubber, etc.)
- Concealed surfaces
- Operating parts
- Identification labels
- Concrete steps, ramps, and sidewalks

Identify the Painting and Decorating Contractor's of America (PDCA) Technical Manual as a reference standard.

Require submission of manufacturer's technical information, label analysis, application instructions and Safety Data Sheets (SDS) for each material proposed. Include cross reference to the specific finish system(s) and substrate(s).

Refer to Table 3 for standard paint colors to be used unless the Project Manager expressly grants an exception. Where color requirements are involved, specify a three-step color selection and approval process, including:

- Selection from manufacturer's color chips
- Verification from 12"x12" draw down cards
- Final confirmation from actual samples in the field
Field samples shall encompass at least 100 square feet, be applied on the actual substrate, utilize the entire finish system, and produce the required sheen, color and texture under (simulated) final lighting conditions.

When epoxy or lacquer materials are specified, include a requirement for providing positive ventilation of the spaces and a requirement that the application be made after 5:00 p.m. on Friday (to allow odors to dissipate over the weekend).

Require submission of an "as-built" color and material schedule for each substrate and finish system with the project closeout documents, including:

- Descriptive location (room number, etc.)
- Manufacturer
- Paint type (name and number)
- Color (name and number)

Part 2 - Products

Pre-approved paint manufacturers are: Dunn Edwards Corp., Sherwin-Williams Paint Co. For exterior stain, add Olympic. See Table 1 – Paint List, Interior for a description of product types and application.

Specify only manufacturer's first quality top-of-the-line products as described in the PDCA manual or by PCC Paint Shop Supervisor.

Specify only materials which comply with all VOC regulations promulgated by the Environmental Protection Agency, and as required for USBBC LEED certification (when applicable).

Specify colors from manufacturer's standard range as specified in Table 3 – Standard Paint Colors. Do not custom match paint colors to other materials unless approved by the PCC Paint Shop Supervisor.

Specify a minimum of 1 coat of primer and 2 coats of finish on all new and existing surfaces. Specify complete paint systems (primers and finish coats) for each substrate and finish.

Specify only primers which are specifically intended for each substrate.

For interior gypsum board walls and ceilings in the following locations use low sheen vinyl acrylic or acrylic paint (See Table 1):

- Classrooms
- Offices
- Corridors
- Stairs
- Dry laboratories
- Janitor closets
- Storage rooms
- Equipment rooms
- All other high use areas

For interior gypsum board walls and ceilings in the following locations use semi-gloss (see Table 1):

- Toilet room ceilings
- Wet laboratories (walls only)
- Animal care areas
- Certain medical care areas
- Shower rooms
- All other areas exposed to substantial moisture

Part 3 – Execution

Specify required protection of adjacent surfaces, and removal/replacement of appurtenances. Require that product data and SDS for each material being used are available on the site.

Specify priming, painting, and finishing of all painted surfaces, covering in detail:

- Required surface preparation (for all new and existing surfaces)
- Application techniques
- Drying times
- Sanding
- Recoating
- Minimum number of coats

Gypsum wallboard to receive separate painting primer coat after it is textured, and prior to the application of the first coat of paint.

Make reference and specify the techniques found in the PDCA manual for a "type 1 standard job".

Include a requirement that each primer and finish coat be inspected through the College's inspection process prior to application of the succeeding coat, and that the color of each coat be slightly varied.

Prior to painting/finishing of metal components, painter to verify that all top and upper surfaces have been seal welded.

Table 1 – Paint List, Interior

PAINT, INTERIOR			
	Dunn Edwards	Sherwin Williams	Other
Surface Prep			
Block Filler	Smooth Blocfil Premium	PrepRite Latex Block Filler	N/A
Patching Compound	N/A	N/A	Custom Building Products Fix-It-All
Drywall Texture	N/A	N/A	Homax Water-Base Orange Peel
Primer			
Gypsum Wallboard	Vinylastic Premium	N/A	N/A
Metal	Ultra-Grip Premium	Pro Industrial Pro-Cryl Universal Acrylic Primer	N/A
Wood	Ultra-Grip Premium	N/A	N/A
Paint			
Standard	Suprema Interior Velvet SPMA20	ProMar 200 Zero VOC Interior Latex Eg-Shel	N/A
Semi-gloss (specified areas only)	Suprema Interior Semi-Gloss SPMA50	ProMar 200 Zero VOC Interior Latex Semi-Gloss	N/A

Table 2 – Paint List, Exterior

PAINT, EXTERIOR			
	Dunn Edwards	Sherwin Williams	Other
Surface Prep			
Block Filler	Smooth Blocfil Premium	PrepRite Latex Block Filler	N/A
Primer			
Masonry & Stucco	Eff-Stop Select	Loxon Concrete & Masonry Primer	N/A
Metal - Aluminum	Ultra-Grip Premium	Pro Industrial Pro-Cryl Universal Acrylic Primer	N/A
Metal - Steel	Bloc-Rust Premium (Water-Based)	Pro Industrial Pro-Cryl Universal Acrylic Primer	N/A
Wood	EZ-Prime Premium	B51W00450 Multi-Purpose Latex Primer	N/A
Paint			
Masonry & Stucco	Evershield EVSH10 (Flat), EVSH20 (Low sheen)	A-100 Exterior Latex Flat	N/A
Metal	Aristoshield ASHL50 (Semi-Gloss)	N/A	N/A
Wood	Evershield EVSH50 (Semi-Gloss)	Sher-Cryl HPA	N/A

Table 3 – Standard Paint Colors

STANDARD PAINT COLORS				
Description	Dunn Edwards		Sherwin Williams	
	Color Number	Color Name	Color Number	Color Name
Orange, pale	DE5192	Fresh Apricot	SW6888	Pizazz Peach
Orange, light	DE5193	Spiced Nectarine	SW6889	Stirring Orange
Orange, medium	DE5194	Tangerine Tango	SW6890	Osage Orange
Orange, bright	DE5195	Bright Mango	SW6891	Mandarin
Cyan, light	DE5834	Azure Sky	SW6793	Bluebell
Cyan, medium	DE5836	Sail Away	SW6794	Flyway
Cyan, bright	DE5837	Pool Party	SW6795	Major Blue
Cyan, dark	DE5838	Summer Lake	SW6796	Blue Plate
Blue, light	DE5892	Blue Cue	SW6809	Lobelia
Blue, medium	DE5893	Bodega Bay	SW6810	Lupine
Blue, dark	DE5895	Dive In	SW6811	Honorable Blue
Gray, light	DE6360	Foil	SW7072	Online
Gray, medium	DE6361	Baby Seal	SW7073	Network Gray
Gray, dark	DE6363	Pointed Rock	SW7075	Web Gray
Black	DEA187	Black	SW6258	Tricorn Black
White, beige	DEC772	Navajo White	SW6126	Navajo White
White, cream	DEW341	Swiss Coffee	SW7008	Alabaster
White, neutral	DEW379	Igloo	SW7004	Snowbound

End of Section 09 90 00

DIVISION 09 - FINISHES

Section 09 94 00 – Decorative Finishing

Introduction

The use of wall coverings is not standard in College work and should be reviewed with the Project Manager. They shall not be used as a wainscot and should only be considered for aesthetic reasons in special purpose areas such as executive offices, conference rooms and lobby areas not subject to abuse. Papers, foils and flocks are not permitted.

Part 1 - General

- Tackable materials should be considered.
- Cross-reference this section with Corner guards, if used.

Part 2 - Products

- Vinyl materials shall be minimum 54 oz.
- Oil base primer or enamel undercoater shall be used to “size” the wall surface.
- Adhesive shall be manufactured or approved by the covering manufacturer.

Part 3 - Execution

- Install covering over abandoned outlet boxes. Fill openings if permanent.
- Only vertical joints are permitted.
- Double cut joints with a straight edge.
- Pattern match, if critical, shall be mentioned in the specification and if necessary to rotate alternate sheets so same edge abuts same edge of roll, it should be so specified to avoid gradations in match at seams.
- Manufacturer’s data sheets shall be provided and a minimum of 9 square yards of each color and type of wall covering used in the project shall be provided as extra stock.

End of Section 09 94 00

DIVISION 10 – SPECIALTIES

Section 10 00 00 - General Discussion

Introduction

The products specified in Division 10 are the pieces and parts that make up the finishing touches of a project. In many cases, they make the room or spaces functional. High quality, serviceability, maintainability and extended product life are the needs upon which this Section is developed. In some cases, qualitative standards are cited for an item(s) and in others, specific product names and manufacturers are cited. When the product or item is cited by name, it is the intention that the name/item(s) be incorporated into the project. In such cases, the College maintain “in-house” expertise, parts and maintenance stock to service the item. Further, it is in the best interest of the College to have consistency if only from the standpoint of the sheer logistics of maintaining and supplying its many buildings.

The consultant should select from the range of products and review and coordinate with the Project Manager and users to determine any special requirements or features for the project.

Chalkboards, Markerboards, and Tackboards

These items, as specified, conform to the College Classroom Design Standards. They are fairly standard and should be specified, sized, selected and customized based on User need and preferences.

Toilet Partitions

Solid Plastic (HDPE) toilet partitions are the product of choice for the College. These have proven to be the most vandal resistant, repairable and serviceable of all the products now in use on campus. There may be instances where stainless steel or other materials may be considered, with approval of the College. Plastic laminate clad wood or particleboard shall not be specified or used.

Corner Guards

Corner guards are a practical solution to a major problem in high use public areas and corridors, in particular where cart and rolling traffic is present. The selected product should be carefully considered and attention to detailing at the tops (where a radius may meet a ceiling grid or wainscot) and bottoms (where base materials may wrap or butt). Termination of wall coverings at corner guards should also be studied and detailed. Color of materials must also be considered for match or contrast with adjacent surfaces.

Signage and Graphics

Generally, interior room signage is detailed, fabricated and installed by the College with coordination with the Design Professional. Establish and coordinate Official College room numbering early in the design process. Since it will be viewed by the campus community, exterior signage and graphics must follow established College policies.

Letters and Plaques

Location of letters, building name and address shall be coordinated with the Project Manager. Recently, building identification has been accomplished with freestanding signage. If letters are provided, size shall be at least 8”. Project Manager shall review style of letters.

Directories and Bulletin Boards

Design should complement the building. Size and location of directory and bulletin board should be coordinated with the User and the Project Manager. Adequate sizes shall be established to allow for building growth and sufficient sets of letters shall be provided with the units. The Consultant shall consider size of letters and tactile marking to comply

with ADA requirements. Units must be of vandal proof construction. For ease of updating, electronic touch screen or digital static directories are becoming more common at the College and are replacing traditional static directories.

Fire Protection Devices

Fire extinguishers will be provided and installed as a part of the construction contract. Type shall be selected as appropriate for the class of equipment being served. Locations shall be shown on the drawings and coordinated with the College's Environmental Health & Safety Department. Also, coordinate locations of AED cabinets with PCC Environmental Health & Safety Department.

Toilet Accessories

Occasionally requirements will vary depending upon whether the project is located on the Campuses or within a Facility. Verify with Project Manager of specifics.

End of Section 10 00 00

DIVISION 10 - SPECIALTIES

Section 10 11 00 – Visual Display Units

Introduction

These items should conform to the College classroom design standards. The products are fairly standard and should be specified, sized, selected and/or customized based on the User's needs and preferences with the concurrence of PCC Technology Services.

Part 1 - General

- Markerboards are preferred over chalkboards primarily because of the problems associated with chalk dust. The College is gradually migrating in this direction but there may be instances where the user group finds chalkboards to be desirable. Chalkboards should be avoided when an appreciable amount of computer and audiovisual equipment is used in the area.
- Locations, mounting heights and sizes should be clearly shown on the drawings and elevations and coordinated with adjacent building elements, projectors, monitors and power/data.
- Material and installation varies by project requirements. Specify markerboard material, shapes, colors (glass, porcelain, magnetic/non-magnetic, framed/frameless, stanchion mounted, flush mounted, mobile, etc.).
- Accessories: Adhesive or Velcro applied aluminum tray to store dry erase markers and erasers.

Part 2 - Products

- Chalkboards and markerboards (whether fixed or moveable) shall be of 3-ply construction consisting of a face sheet, core material and backing.
 - Face sheet shall be one piece 24 gauge porcelain enamel steel skin (magnetic) with appropriate fused surface for either chalkboards or dry erase markerboards. Surface for chalkboards shall be similar to "Vitracite" by Claridge with matte finish, color: Black only. Surface for markerboards shall be similar to "LCS" by Claridge with high gloss finish intended for use with liquid felt-tipped markers, color: White or Light Gray.
 - Core for fixed units shall be minimum 3/8" particleboard or Duracore. Core for moveable units shall be minimum 3/8" heavy kraft paper honeycomb.
 - Backing for fixed units shall be aluminum foil. Backing for moveable units shall be 26 gauge galvanized steel sheet.
 - Accessories (fixed boards): Provide continuous extruded aluminum chalk tray at bottom of board. Provide cork tack strip along top of board with sliding map clips every twelve inches.
 - Aluminum frame and accessories shall be clear anodized aluminum finish.
- Sliding units: Operation should be easy and quiet with no rattling of panel within the track. Provide units with integral continuous accessory tray. Motorized units may be considered depending on the application with the approval of FM.
- Sliding units may either be surface mounted or floor mounted with a kick panel. In either case the back fixed surface should be utilized as a similar writing surface or a projection surface. Bare walls behind the vertical sliding units should be avoided. Kick panel surface should be specified to compliment the adjacent finishes.
- Any individual unit should not be larger than 16' feet long.

- Tackboards should be natural cork product combined with linseed oil laminated on a burlap backing with natural pigments that go through to the backing. Preferred color is tan. Product shall be self-healing, soil resistant, washable, have a low light reflectance and not contain any toxins or harmful emissions. Minimum thickness of cork should be $\frac{1}{4}$ ". Boards may be additionally mounted on hardboard backing for rigidity.

Part 3 - Execution

- If the markerboard is intended to also serve as a projection surface, ensure that the installation height is coordinated with the projector lens height. A general rule is that the top of the marker board should be no less than the centerline of the projector lens.
- Require manufacturer's recommended maintenance and cleaning procedures; including cleaning products, cloths and precautions for cleaning materials and methods that could be detrimental to the specified finish.
- Provide the maximum manufacturer's available guarantee.

End of Section 10 11 00

DIVISION 10 - SPECIALTIES

Section 10 13 00 - Directories

Introduction

Design should complement the building. Size and location of directory and bulletin boards should be coordinated with the User and the Project Manager.

Adequate sizes shall be established to allow for building growth and sufficient sets of letters shall be provided with the units. Size of letters and tactile marking to comply with ADA requirements shall be considered.

Part 1 - General

- Units shall be vandal proof construction

Part 2 - Products

- There are no unique College requirements.

Part 3 - Execution

- Mounting shall be concealed and vandal proof.

End of Section 10 13 00

DIVISION 10 - SPECIALTIES

Section 10 14 00 – Signage

Introduction

All exterior signs shall comply with the College’s Wayfinding Standards.

Part 1 - General

- Compliance with the Exterior Sign Manual is to ensure the implementation of a comprehensive and consistent campus-wide exterior sign program including but not limited to: identification, directional, informational, and regulatory signs.
- Generally, projects that entail new facility construction, additions to existing facilities, facility renovations that involve change of use, site modifications, and other similar work will require new exterior signage or changes to existing exterior signage.
- Where exterior signage is required, it will be the responsibility of the project to include exterior signage in the Scope of work and the project budget.
- It shall be the responsibility of the Design Consultant in conjunction with the User to first identify and then document the extent, location, size, text, graphics, color, materials and other signage elements consistent with the criteria in the Exterior Sign Manual.
- It is recommended that signage development be initiated early in the design of the project.
- All Exterior Signage must be reviewed and approved Pima Community College Facilities & Operations
- Copies of the Exterior Signage Guide should be obtained and coordinated through the Project Manager.

Part 2 - Products

- No discussion

Part 3 – Execution

- No discussion

End of Section 10 14 00

DIVISION 10 - SPECIALTIES

Section 10 14 16 - Plaques

Introduction

A cast metal dedication plaque has traditionally been required on all capital ABOR projects. The dedication plaque shall be furnished and installed as part of the construction project.

Part 1 - General

- Plaque shall be identified on the drawings and located near the building entrance, just inside or outside of the main entry doors. For building additions, the location of the new plaque shall not conflict with or replace the location of the existing plaque(s).
- Pima Community College Manual of Design and Specifications Standards Manual, Detail 10 14 16-D1 shall be used to provide a dimensioned elevation view and details of the plaque in the project specification. No deviations from this standard will be allowed for new buildings. For building additions endeavor to match the details of the existing original plaque(s).
- Text for plaque shall be furnished by the College and adhere to the following traditions:
 - The date shall be the year in which the construction effort was complete.
 - The names of the Governor, members of the Board and Chancellor of the College are those that held office at the time the construction contract was awarded.
 - The above information as well as the name of the building shall be verified in writing with the Pima Community College President's Office via the office of the Senior Vice President of Business Affairs.
 - The names of the Architect, Contractor and Project Manager (if applicable) shall be the same as that contained in their respective contracts.
 - Exact text for plaque will typically not be available at the time the project is bid. Consequently, for estimating and bidding purposes, only an example of the text can be provided or an allowance of 400 letters established. Exact text shall be confirmed as part of the shop drawing review process.
- Shop drawing submittal shall include an accurate scaled drawing of the plaque showing complete layout and size of text as well as large scale details of letters, border style and anchoring method.

Part 2 - Products

- Refer to dedication plaque drawing 10420-D1 for details and attributes of plaques.
- One vendor that has been used for past College dedication plaques is A.R.K. Ramos. Their contact information is:

A.R.K. Ramos Signage Systems
P.O. Box 26388
Oklahoma City, OK. 73126
Phone: 405-235-5505
Toll Free: 1-800-725-7266
Website: www.arkramos.com

Part 3 – Execution

- After installation clean and protect plaque until final acceptance by the College.

UA BUILDING DEDICATION PLAQUE:
Material: Cast aluminum
Border: Plain (square) border profile, painted black
Field: sandblasted aluminum finish, A.R.K. Ramos "matte" texture
Font: Milo, sans serif, recessed letters painted black
Logo: Standard UA Block A (3-1/4" H)
Mounting: Concealed anchor

Cast aluminum plaque should be used for new buildings and modern additions to non-historic buildings. Cast bronze should be used for additions/alterations to historic buildings.

SECTION DETAIL

FONT SIZES

- 1- 1/8"
- 1-1/2"
- 1"
- 3/4"
- 5/8"
- 3/4"
- 5/8"
- 1- 1/8"
- 3-1/4"

THE UNIVERSITY OF ARIZONA	
MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL: DEDICATION PLAQUE	
DRAWN BY: E. GALDA	DETAIL NO.
APPROVED BY: B. DOLAN	10420-01
July 2015	
REVISIONS	

DIVISION 10 - SPECIALTIES

Section 10 21 13 - Toilet Compartments

Introduction

Toilet compartments are subject to considerable use, damage and vandalism. Consequently, they need to be given considerable attention to ensure that they will withstand this abuse and not present a constant maintenance burden.

Wood and wood laminate partitions are not to be used.

Part 1 - General

- Toilet compartments are subject to vandalism and therefore must be adequately braced and constructed of material that is not easily defaced or deformed.

Part 2 - Products

- Toilet partitions, compartments, doors and screens should be constructed of solid plastic (HDPE high-density polyethylene) or standard fabricated hollow metal. Customized shapes and configurations should be avoided.
- Metal panels are best fabricated from heavy gauge brushed stainless steel as it the most resistant to defacing and easiest to clean and maintain. Painted or enameled metal panels are discouraged, as they are easily defaced.
- Partition supports and pilasters should at least be specified for floor and wall attachment. Additionally, attach to ceiling bracing if possible. Partitions that are attached only to the ceiling and walls must be avoided. Provide anti-grip type overhead braces over door openings.
- Pilaster shoes and caps should be attached with manufactured clips.
- All fasteners and assembly screws shall be tamper proof. Partitions shall be attached to wall with no less than three brackets. Brackets shall be secured with no less than two fasteners.
- All hardware shall be heavy-duty institutional type. Door hinges shall be adjustable self-closing.
- Doors on accessible stalls shall be out-swinging. Doors on standard stalls shall be in swinging. Provide pulls on both sides of out-swinging doors to accessible stalls. Reference Facilities Guidelines and Specification Standards , Section 10 28 13 – Toilet Accessories and Tab B-7 – Campus Accessibility.
- Screens shall be attached with wall brackets and a front supporting post secured to the floor to provide additional resistance from lateral impact.

Part 3 - Execution

- Adjust hinges so that both in-swinging and accessible out-swinging doors remain open at a 30-degree angle when unlatched. All partitions, compartments and doors shall be installed so all edges are plumb, level and parallel. Protect during construction and clean prior to acceptance.

End of Section 10 21 13

DIVISION 10 - SPECIALTIES

Section 10 26 00 - Wall and Door Protection

Introduction

High impact protection of exposed interior corners is necessary for building maintenance. Corner guards shall be incorporated into the design documents as an integral part of the overall interior design and finished space.

Identify the location and quantities of corners guards. At minimum, corner guards shall be installed on all outside corners in high use traffic areas, including bump outs at wall niches and on all outside corners on interior columns.

Consider locations where added wall protection will help reduce damage from occupant use and routine cleaning operations. Surfaces may include cased openings and wall surfaces subject to damage from furniture (conference room chairs).

Part 1 - General

- For interior renovations or addition type projects, consider matching the existing building standard finish and color for a cohesive design and for ease of routine maintenance and replacement.
- 4'-0" Min. Height, or per project requirements.
- Adhesive applied; Install above wall base.

Part 2 - Products

- Stainless Steel: Type 304, Min. 18 gauge, #4 satin finish, 90 degree.
- Heavy duty PVC, Rubber or Vinyl materials may be considered. Review with Project Manager.

Part 3- Execution

- Manufacturers installation literature shall be followed with sufficient backup provided for support.
- Care shall be taken not to void fire ratings of walls.

End of Section 10 26 00

DIVISION 10 – SPECIALTIES

Section 10 28 13 - Toilet Accessories

Introduction

This section addresses the type of accessories that are to be provided or anticipated for all new and remodeled restrooms. The following accessories requirements are for toilet rooms, which will be serviced and maintained by Facilities.

Pre-installation meeting with contractor, Project Manager is required to confirm the locations and mounting heights of all accessories.

Requirements for toilet accessories may vary depending upon whether the project is located on Campuses or within a Facility. All assumptions shall be verified with the Project Manager and the respective custodial group.

Part 1 – General

- Reference Manual of Design and Specifications Standards Manual, TAB C-12 for graphic elevation diagram and installation heights.
- For new and renovation projects, Custodial Services will provide as part of FFE, hand soap, paper towel and toilet tissue dispensers for installation by the contractor. Consultant to note these three items in project specifications and Toilet Accessories Schedule as "OFCl". All dispensing units shall be surface mounted. Recessed elements are to be avoided. Stud walls should receive appropriate blocking to accommodate surface mount attachment.
- Freestanding Trash receptacles are to be located or at least anticipated in every restroom. Project manager will purchase trash receptacles through Custodial Services as part of FFE (OFOI). Exception: in some cases, the design team will specify waste/recycle receptacles as part of project requirements. (CFCl).
- Counter mounted pump type soap dispensers are not used on campus.
- Provide an Accessories Schedule in the specifications or on the drawings listing each room and the quantity of each type of accessory required as well as who provides what elements and who installs.
- Consultant should anticipate and coordinate locations for any other miscellaneous owner furnished elements.

Part 2 – Products/Space Planning

- Paper towel dispensers:
Provided by Custodial Services as part of FFE. For space planning purposes, dispensers shall be surface mount, high impact plastic with push paddle or touchless operation. Confirm current model with custodial during design phase. Paper towel dispensers project approximately 12" into the floor space and therefore should not be installed in the path of travel. Position dispensers adjacent to sink on side return walls where possible and ensure dispenser does not overlap the 30x48 wheelchair clear space at sink. Provide at least one paper towel dispenser for every three sinks and install with operable mechanism at 42" max above the finished floor.
- Where provided, (Project specific; confirm with Project Manager) electric hand dryers with bottom air outlet shall be located so that operating mechanism is at 40" above the finished floor. Hand dryers that hands are inserted into, shall be located so that top of unit is 36" above the finished floor.
- Soap dispensers:

Provided by Custodial Services via their soap vendor and are surface mounted (GOJO brand approx. dimensions 9Hx6Wx5D); confirm current model with custodial at time of design. Install "front reach" soap dispensers on sink walls at a consistent low height; at the top of the backsplash or adjacent to mirrors. Provide one soap dispenser adjacent to a sink on the side return wall where possible, to reduce length of reach. Locate operable mechanism at 42" max above the finished floor.

- Toilet Paper Dispensers:
Provided by Custodial Services as part of FFE. For space planning purposes, dispensers shall be surface mounted, Georgia Pacific Compact Quad Vertical Four Roll Coreless type for regular toilet stalls. Compact Side by Side Double Roll type (10Wx6Dx7H) are required for wheelchair accessible stalls, ambulatory stalls and accessible single occupant toilet rooms. Install the Side by Side Double Roll dispenser so that the centerline of the dispenser is located 7" from the front edge of the toilet bowl. Maintain 2" clear space below the grab bar to the top of the dispenser.

NOTE: Quad/Four Roll dispenser types or jumbo single roll types are NOT allowed in wheelchair accessible stalls, ambulatory stalls or accessible single occupant/gender-neutral toilet rooms.

- Sanitary Napkin disposal units:
Custodial Services will provide freestanding floor boxes as part of FFE. For a surface mounted option, consultant to specify Bobrick Contura Series B-270 in stainless steel finish. (Custodial provides the trash bag liners but does not supply the dispenser). Handicap Accessible stalls and Ambulatory stalls: install unit toward the back of stall, behind the toilet paper dispenser with 4 inches CLEARANCE UNDER THE GRAB BAR. At regular stalls, install unit toward the front of stall, in front of the toilet paper dispenser.
- Waste receptacles:
Provided by Custodial Services as part of FFE and will typically be a freestanding "Slim-line" type unit for most restrooms. Recessed or wall mounted receptacles are not acceptable. Under- counter trash receptacles with a countertop cutout are acceptable. Consultant to anticipate space planning for trash receptacles to ensure the layout meets accessible clear floor space requirements, particularly for waste receptacles adjacent to entry/exit doors.
- Grab bars:
Shall be stainless steel, 18-gauge minimum wall thickness, and 1.5" minimum outside diameter with concealed mounting devices. Install to provide 1.5" clearance between wall and inside face of handrail. Provide vertical grab bar at water closets in wheelchair accessible, ambulatory stalls and accessible single use restrooms. Comply with ANSI standards for size and placement of vertical grab bar.
- For accessible and ambulatory toilet partition doors that swing out:
Specify two additional pulls on the interior side of the stall door. Pulls must be operable with a closed fist and mounted horizontally 0.5" min. wide opening, with 1 ¼" clearance. Locate one pull adjacent to, and at the same height as the door latch. Locate the second pull near the door hinge at 36" AFF and 8" away from the hinge.
- Coat Hooks:
Specify one hook for each toilet partition at all accessible and ambulatory stall doors. Specify one hook in the center of the door at 42" AFF (and not above the latch) or locate on a side wall or partition in end of row stalls, away from the side grab bar so hanging items will not conflict with grab bar clearance. Where occurs, specify one towel/coat hook at all showers at 42" AFF.
- Mirrors:
Shall be 1/4" glass with stainless steel frame and concealed fasteners. Locate and size mirror to provide adequate free wall space for soap dispenser. Provide full length framed mirror in multi-stall restrooms and accessible single occupant/all gender-neutral toilet rooms. Consider best wall location for viewing and to avoid sight lines into the room.

- Seat cover dispensers:
Project specific; confirm with PM.
- Baby Changing Tables:
Project specific; confirm with PM. When required, specify type Koala Kare Products KB200 horizontal wall mounted, surface mounted and constructed of injection-molded polypropylene. Color to be selected by architect from standard finishes. Locate tables: in main public restroom block and accessible single occupant/gender-neutral toilet rooms. Install so that at the open and lowered position, surface is 34" above the floor. In the closed position, the station cannot overlap required floor spaces at fixtures or maneuvering clearances. Stations are not permitted within a water closet stall but can be located in single toilet rooms if maneuverable clearance space is maintained.

Part 3 - Execution

- Provide stud wall backing for all surface mounted accessories.
- Protect all toilet accessories from damage during the course of construction.
- Clean all surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.
- Locate all accessories to ensure that surface mount elements are cane detectable, do not restrict access to sinks or impede path of travel.

End of Section 10 28 13

DIVISION 10 - SPECIALTIES

Section 10 44 16 - Fire Extinguishers

Introduction

Fire extinguishers shall be provided and installed as a part of the construction contract. Type shall be selected as appropriate for the class of equipment being served.

Locations shall be shown on the drawings.

Part 1 - General

- Cabinets shall be large enough to contain a 10# dry chemical type extinguisher. Coordinate wall thickness to ensure adequate depth is provided.
- Mounting brackets shall be provided for extinguishers not located in cabinets. Signs must be posted.

Part 2 - Products

- Fire extinguishers shall generally be multi-purpose dry chemical type, UL rated, 4-A:60-B:C, 10lb nominal capacity, in enameled steel container for Class A, Class B and Class C fires.
- Fire extinguisher cabinets shall be either semi or fully recessed type (fully recessed is preferred) with enameled steel box and with a non-locking mechanism. Exposed trim, door material, door style and hardware (no locks) shall be as selected by the Consultant and appropriate to the design of the building. Lobbies, public spaces, corridors and the like may have upgraded materials in keeping with the building design. In less public areas, polished, non-directional #4 stainless steel should be considered for door material.
- Some areas may require a different type of extinguisher other than dry chemical.

Part 3 - Execution

- Securely fasten mountings to building.
- Cabinets shall be identified with lettering spelling "FIRE EXTINGUISHER".

End of Section 10 44 16

DIVISION 10 - SPECIALTIES

Section 10 81 13 – Bird Control Devices

Introduction

Pigeon roosting and congregation is an ongoing problem at the College. Specify appropriate bird control systems whenever conditions are created that might enable pigeon roosting or congregation over occupied or pedestrian areas or where resultant roosting will create unsightly conditions. Areas where food service is available may need extra special attention.

Part 1 - General

- Generally, ledges, windowsills, overhanging shade devices, roof peaks and edge conditions should be evaluated for application.
- For small isolated areas, parapet walls and roof edges, a stainless steel bird spike system may be sufficient.

Part 2 – Products

- For larger overhangs or windowsills or where deterrence has been identified as a special requirement, a low voltage electric system such as the Avian Averting System® by Avian Flyaway, Inc. is recommended. Contact information is as follows:

Avian Flyaway, Inc.
Western Regional Office
1645 W. Valencia Rd.
Suite 109-514
Tucson, AZ 85746
Phone: (520) 889-7303
Fax: (520) 889-1375
<http://www.avianflyawayinc.com/>

Part 3 – Execution

- No discussion

End of Section 10 81 13

DIVISION 11 - EQUIPMENT

Section 11 05 00 – Compact Shelving

Introduction

Compact shelving format is to be established during programming and design phases with the affected College Department and the Design Professional.

Part 1 - General

- Compact shelving may be manually or electrically operated.

Part 2 - Products

- If the compact shelving is electrically operated, then the following criteria should be requested:
 - All electrical wiring and equipment shall comply with the current NEC, class 1 circuit, Article 725.
 - The class 1 circuit limited power shall be from the fused control box to the wiring on the load side of the control box.
 - Flexible cords and cables will be allowed if the class 1 circuit is totally in compliance with Article 400 & 725 of the current NEC. This class 1 circuit shall not include wiring to the light fixtures on or associated with the compact shelving. Cords shall be rated for service encountered.
 - All wiring and equipment shall be grounded and bonded according to Article 250 or the applicable article of the current NEC.
 - All wiring methods shall be installed according to Article 300 of the current NEC.
 - All electrical devices, materials and equipment shall be listed and approved by a Pima Community College approved testing laboratory and shall be used for its approved listing and it's intended purpose. Motors shall be suitable for duty encountered and the motor controls shall be readily accessible. Laboratory listing and component listing shall be a performed by U.L., C.S.A., F.M., City of Los Angeles or other laboratory approved by Pima Community College
 - Light fixtures shall be wired with M/C cable or other approved means. This cable shall be no larger than 3/8" in size.
 - Motor protection shall comply with current NEC, Article 430.
 - Light fixtures shall be approved for feed-through application on their listing label or shall be installed with a junction box external to the fixture to accommodate feeding the next fixture. Ballasts shall be Magnatec, Advanced or other Pima Community College approved manufacturer.
 - Fixture shall have CR85, T-8, 4100K lamps and shall meet the EPA requirement for non-hazardous disposal.
 - All penetrations for cords, cables or the like shall have an approved bushing installed wherever the wiring method passes through any metal enclosure, pipe, channel, light fixture, etc. This applies at all ends of hollow metal channels also.

Part 3 - Execution

- If the compact shelving is electrically generated then the following should be requested:
 - All compact shelving wiring shall be inspected and approved by Pima Community College Facilities Construction & Planning Department Inspectors.
 - The compact shelving representative shall meet with College Representatives prior to installing any electrical wiring, devices, or equipment, to review any changes or variations in the applicable code or Pima Community College Standards.

End of Section 11 05 00

DIVISION 11 - EQUIPMENT

Section 11 52 13 - Projection Screens

Introduction

Verify information with the User Support Services: Educational Technology Team.

Ceiling mounting is preferred to clear wall mounted items. Mounting shall be secure and durable. "S" or "J" hooks shall be closed.

Lecture hall screens shall be electrically operated and laid out so that motor is accessible and fire ratings of ceiling and wall surfaces are not interrupted. 110V switch is provided for operation at a wall location and 24V switch is required for operation at a lectern.

Manual pull down screens shall be not less than 8' wide.

Part 1 - General

Reference Division 26 - Electrical if the screens are electrically operated

Part 2 - Products

Front view projection screens shall be a matte white polyester viewing surface with 1.2 grain characteristics complying with FS GG-S-00172D(1) for type A screen surface. Screens shall be seamless construction, mildew resistant and comply with NFPA 701 for fire performance characteristics.

Where video projection is provided in the room, a "tab tension" shall be provided (to provide a uniform surface across the surface of the screen).

Part 3 - Execution

There are no unique College requirements.

End of Section 11 52 13

DIVISION 12 - FURNISHINGS

Section 12 00 00 - General Discussion

Introduction

This general discussion section contains material that is important to the successful fabrication and/or installation of furnishings and equipment in construction projects. The issues are fundamental to the basic design of the project, and the long-term success of those elements of the project, as well as the fabrication and installation process.

The consultant is expressly responsible for incorporating these overall requirements into the project, and for insuring that all the sub consultants are aware of the requirements and incorporate them into their designs as well.

Furniture

Items available through the Tri-University Purchasing Agreement are purchased by that means. Other items are bid through the Purchasing Department in compliance with the College Procurement Code. Furnishings are not usually a part of the building construction contract.

End of Section 12 00 00

DIVISION 12 - FURNISHINGS

Section 12 21 00 – Window Blinds

Introduction

Window blinds may be a part of the construction contract (preferable if there is no furniture contract).

Details should provide for proper attachment with backing as required for the attachment. If blinds will sit in front of windows, insure that they will clear furnishings. If blinds sit within window recess, make certain depth of recess is adequate for proper installation.

Vertical or horizontal blinds may be at the discretion of the Design Consultant (Users occasionally have preferences.) Overall building appearance should be considered and if a standard has been established, that standard should be maintained so exterior appearance is consistent. Generally, vertical blinds do not retain dust and horizontal blinds do. Mini-blinds are preferred if horizontal and in either case, metal is preferred.

Specifically indicate on the plans the locations of the blinds.

Part 1 - General

- There are no unique College requirements.

Part 2 - Products

- There are no unique College requirements.

Part 3 - Execution

- There are no unique College requirements.

End of Section 12 21 00

DIVISION 12 - FURNISHINGS

Section 12 35 53 - Laboratory Casework

Introduction

These Standards differentiate between Laboratory Casework and Millwork because of the specialized nature and use of the product. Millwork shall be specified separately in Division 06 - Wood and Plastics.

Because the College anticipates a longer than average building life and higher than average use and abuse, durable, high quality Laboratory Casework is essential to the long-term success and serviceability of any project. Section 12 35 53 - Laboratory Casework specifies current Standards of the American Woodworking Institute (AWI) but modifies the standard to omit the use of certain materials in certain conditions and in certain portions of the work. Although used extensively industry wide, in the experience of the College, these materials have proven unsatisfactory and must be specifically excluded from the specifications.

Part 1 - General

- Laboratory Casework shall be fabricated to current standards of the American Woodworking Institute (AWI) and within the guidelines of the Scientific Apparatus Manufacturers Association (SAMA). Specific project requirements will determine the need for acid and chemical resistant acrylic, chemical resistant solid phenolic plastic, acid resistant plastic laminate, or standard plastic laminate counter tops.
- Indicate requirements for utility provisions, which must be coordinated by the fabricator.
- Reference appropriate sections for Laboratory Tops and Equipment. (See Tab B-1 Laboratory Planning and Design Criteria.)

Part 2 - Products

- All Laboratory Casework shall be "Custom" grade according to the American Woodwork Institute (AWI) and subject to the following:
- No particleboard or particleboard core plywood may be used in any part of the work (including laminate tops) and shall be specifically excluded. Plywood shall be industrial quality.
- Casework shall be opaque or transparent finish rotary cut uniform color light birch hardwood (unless otherwise approved by the Project Manager). Architect shall specify finish and call for sample submittal for review and approval. Interior of millwork shall receive opaque or transparent finish to match exterior.
- Pre-approved fabricators and manufacturers of Laboratory Casework should contact PCC Environmental Health & Safety Department.
- The lists in this section are non-exclusionary and not intended to be a comprehensive list of qualified fabricators and manufacturers. These lists are intended to identify Fabricators and manufacturers that have met the design and specification standards that are identified in this Section. Other fabricators and manufacturers that can meet the design and specification standards in this Section may be considered.
- The pre-approved material that is required for laboratory countertops shall be made of solid phenolic plastic.
- Minimum grades for plastic laminates shall be as follows (NEMA / ISO / Inch Thickness). For horizontal surfaces use HW62/HCS/.062" or GP50/HGS/.050" and for vertical surfaces use BK50/BGS/.050". Do not specify post-forming grades of Laminates.

- Pre-approved manufacturers of plastic laminate are:
 - Wilson Art
 - Formica
 - Nevamar
 - Pionite
- Hardware shall be indicated in a schedule in this section or in Section 08 70 00 - Hardware. If in Section 08 70 00, reference to that section.
- Drawer glides shall be full extension Heavy duty rated.
- Hinges shall be concealed type full metal with no plastic parts, 180° degree opening capacity.
- Hardware for adjustable shelves in cabinet bodies shall be K-V adjustable track with metal shelf support.
- Hardware for adjustable shelves on walls shall be heavy-duty type equal to the K-V standard and bracket system.
- Pre-approved hardware manufacturers are:
 - McKinney
 - K&V
 - Blum
 - Stanley
 - Gras

Part 3 - Execution

- Fabricate case bodies with stop dadoes if transparent finish.
- All "Custom" grade Casework concealed surfaces shall be treated at the shop with spray or brush application of 50% Pentachlorophenol solution in a 1:10 mixture with deodorized spray base. In the field, all concealed scribed and cut surfaces shall receive a brush application of the same material.
- Drawers shall be lock shouldered or multiple dovetailed and have applied fronts. Bodies shall be hardwood or 7-ply plywood. Bottoms shall be hardwood panel product or masonite hardboard full or stop dadoed. Exposed surfaces shall be hardwood. All drawers shall ride on full extension, full suspension drawer glides.
- Plastic laminate application shall be specified as follows:
 - Apply side edging first, then top surface, with top surface overlapping side edging.
- Installations shall be by skilled tradesmen. In the cases where fabricator and installer are not one and the same, product and project guarantee shall not be compromised.

End of Section 12 35 53

DIVISION 12 - FURNISHINGS

Section 12 48 13 – Entrance Floor Mats and Frames

Introduction

Recessed floor mats must be provided at building entrances. Exterior installations are preferred.

Part 1 - General

- Require submittal of appropriate samples for approval and review of colors if applicable.

Part 2 - Products

- Frames shall be recessed and of aluminum, bronze or other material complimentary to the building design.
- Metal foot grille type shall be specified. Size of panels shall be such that they are easily removed for cleaning. Joints shall divide the units into equal sections and material pattern in each section shall align with the adjacent sections.

Part 3 - Execution

- Comply with manufacturer's instructions and coordinate top of mat surfaces with doors so that swing across mats provides under door clearance.

End of Section 12 48 13

DIVISION 12 - FURNISHINGS

Section 12 65 00 – Multiple-Use Fixed Seating

Introduction

No discussion.

Part 1 - General

- Seating Layout: Design and install seating to optimize sight lines and space utilization. Comply with ADA Rules and Regulations. Architect shall provide initial layout and plans in a diagrammatic form showing number of seats, minimum aisle widths, H.C. seating spaces and armrest locations, aisle lighting and other requirements.
- Specify single-source responsibilities. Obtain seating, accessories, mounting components, including installation and coordination responsibilities from a single manufacturer.

Part 2 - Products

- Lecture Hall and Auditorium Seating:
 - Floor mounted fully padded, fabric-covered seats with molded plastic backs and heavy gauge steel seat frame and pan. Provide self-rising mechanisms. Do not use rail-mounted systems.
 - Lecture Hall seating shall have folding tablet arms with nominal plastic laminate writing surface on hardwood plywood core, with rounded edges. Provide 13% of tablet arms for left-handers located on aisle seats.
- Arena Seating:
 - Riser mounted molded plastic with and without fabric covered padded seats (as required by the building program). Standards shall be cast iron.

All seats shall be provided with Manufacturer's standard number and letter plates after determining seat/row designations with the College.

- Acceptable Manufacturers:
 - American Seating Col.
 - Hussey Mfg. Co.
 - Irwin

Part 3 - Execution

- Comply with recommendations of seating manufacturer for secure and proper installation.
- Install chairs using manufacturer's recommended hardware and fasteners. Chairs in curved rows shall be installed at smooth radius.
- Mounting bolts and assembly hardware shall be cut, capped and/or otherwise finished to achieve both a finished appearance to the installation and eliminate protrusions and sharp edges, which could cut and tear.

End of Section 12 65 00

DIVISION 14 - CONVEYING EQUIPMENT

Section 14 00 00 - General Discussion

Introduction

The size, number, and location of elevators must be addressed at the earliest stages of the design, to ensure that neither the overall function of the facility nor the optimum configuration of elevators is compromised. The size and location of the machine room is similarly critical.

Provide a minimum elevator machine room size of 100 square feet, exclusive of the area above the hoistway (for traction elevators), and without any odd corners, narrow passages or structural interferences.

Consultant shall design elevators to comply with current ASME A117.1, ASME A117.2, UBC and NEC codes.

When new elevators are being installed into existing buildings where elevators do not currently exist (as opposed to elevator modernization) comply with the criteria for new elevators to the most practical degree (extent) possible.

The Consultant is expressly responsible for incorporating these overall requirements into the project, and for ensuring that all sub-consultants are aware of the requirements and incorporate them into their designs as well.

Reliance on "after-the-fact" equipment selections to compensate for a problematic design decision is unacceptable.

Consultant is encouraged to develop the basic building design so that stairs are the naturally preferred mode of vertical travel.

Service elevators shall be located near the loading dock.

Basic Elevator Selection

Hydraulic elevators are generally used in low-rise buildings with two to three floors. Electric traction elevators are generally used in buildings over three stories. Consultant shall coordinate the electrical requirements as well as the code requirements for the pit, overhead clearance, shaft ventilation, pit ladder, light (with switch adjacent to ladder) and electrical duplex 120 VAC outlet in pit, equipment room and phone in cab.

In addition to this general discussion section, refer to the following applicable sections:

- Section 14 21 00 – Electric Traction Elevators
- Section 14 24 00 – Hydraulic Elevators
- Section 14 28 16 - Elevator Controls
- Section 14 40 00 – Lifts

Fire Alarms and Protection

Do not install sprinklers in the elevator hoistways unless required by the applicable codes. These requirements would include:

- The hoistway of a freight elevator.
- The hoistway of any elevator with a polyethylene coated or flammable belt material.
- The hoistway of a hydraulic elevator containing a hydraulic fluid with a flashpoint below the limit established by PCC Environmental Health & Safety.
- A hoistway of combustible construction.
- The hoistway for a car not compliant with ASME A17.1 for car construction.

Pima Community College
Facilities Guidelines and Specification Standards

Smoke / heat detectors in the hoistways will only be required in association with required sprinklers as stated above and applied per NFPA 72 and ASME A17.1. Supplemental heat detectors are required within 24 inches of each required sprinkler head for activation of a shunt trip circuit. The shunt trip circuit will shut off elevator equipment power prior to the discharge of water from the sprinkler system.

NFPA 13 & 72, ASME A17.1 and the IBC will dictate the balance of sprinkler and initiating device application throughout the related elevator spaces.

College Checklist

The following checklist is used by the College when reviewing elevator drawings and specifications. The Consultant is encouraged to review this against his specifications to insure completeness at the time of submittal.

Motion Control Engineering Controls	Motion control performance
Modem and connections	ADA phone and make connections
Shunt trip breaker w/ heat detector	GFI breakers on 120 V. circuits, M/R and hoistway
Sump pump in elevator pit	Run phone wires for emergency phone and modem
Fire Service	Vent and cool M/R
Mount controller on M/R wall to prevent vibration	Lockable car light switch in M/R
Submersible pump on hydraulic pump units	Oil return pump
Duplex receptacle in pit	Pit depth
Pit ladder	Pit stop switch next to ladder
Pit light switch next to ladder	Sump pump in pit
Hoist way overhead clearance	Vent hoistway (unobstructed)
PVC casing around jack assembly	Paint fascia
Emergency light located in car control station Car control station shall be hinged	Hall position indicator at main lobby only
Car position indicator and swing for easy access	2-way voice emergency communication required for building height > 60'
COP Maintenance panel key to (Northeast J200)	Tamper resistant fixtures by EPCO
Hall lanterns (directional arrows)	Meet ADA requirements (Braille & audible signals)
All fixtures illuminated by LED's	Light & fan switches keyed to EPCO-1 Independent service keyed to EPCO-1
Stop switch keyed to EPCO-1	Smoke detectors to be compatible
Fire service switch keyed to AZFS	Provide protective cab blankets & hooks
Provide emergency access in all hall hoist way doors with and tie into building system	Engrave building name and elevator # in car control panel
S.S. Handrails	GAL door equipment
Squirrel cage fan single speed	Nudging
Photo curtain (Gatekeeper 2000 by Adams)	Test equipment
Instruct College	12 month warranty and maintenance w/24 hour coverage at no added cost
As-built drawing, parts list, instructions (in triplicate)	Verify M/R access, slope ships ladder to be less than 60°
Key lock out to be mortised and accept Sargent & Medico cylinders	Self-closing self-latch machine room
Fire extinguisher in all machine rooms	Shunt trip control circuits monitored
Elevator shutdown (shunt trip) doors	

- Ancillary electrical elevator equipment shall be fed from a separate, solely dedicated, elevator electrical LOAD CENTER. This elevator load center shall only be used for elevator related equipment and devices. It will provide the required means to lockout the equipment for service. Required characteristics of elevator electrical Load center are: surface mounted, copper bus, no door, dead front, 14 inches wide, lockable (lockout) breakers and a maximum size of 12 full size breaker spaces. Additional spaces are authorized only where the number of elevator related loads increases above 12 spaces. Unused breaker spaces shall not have any spare breakers installed. Ancillary elevator equipment to be fed from this panel may be, but is not limited to, the following:

- Shunt trip control feed
 - Machine room lights/receptacles
 - Elevator car lights
 - Elevator pit lights/GFI receptacle
 - Elevator pit sump pump
 - Machine room A/C
 - Elevator Fan (A/C)
 - Hydraulic oil cooler
- Main electrical elevator feed should employ a molded case shunt trip breaker and a suitably sized enclosure. Larger enclosures for electronic type breakers are to be avoided as they take up too much room in an already cramped service space. Requirements for electrical coordination to be accomplished upstream of the main elevator feed.

Refer to attached pages 14 00 00-4 through 14 00 00-13 for “Construction Guidelines for Elevators”, “Firefighters Service/Shutdown Requirements” and “Inspection Requirements Checklist” presented by The Industrial Commission of Arizona.



CONSTRUCTION GUIDELINES FOR ELEVATORS

(Per ASME A17.1- 2007⁷ Elevator Safety Code and other applicable codes)



HOISTWAY / HOISTWAY MACHINERY SPACE / PIT

pg. 1 3-10

- 1) Sec. 2.1/2.7 - Provide hoistway enclosure conforming to all applicable codes. Fire-resistance ratings of hoistways and machinery spaces shall conform to the building code. Seal all gaps and penetrations.
- 2) Rule 2.1.1.2.2.(e) - Where applicable, hoistway glass shall be laminated and each piece visibly marked as per ANSI Z97.1 or 16 CFR Part 1201. Windows are prohibited in hoistways.
- 3) Rule 2.1.4 - Hoistway ventilation to the outer air shall be provided, per the building code, for elevators penetrating more than three floors. The area of the hoistway vent shall not be less than 3 ½ percent of the area of the hoistway nor less than 3 square feet for each elevator car.
- 4) Rule 2.1.6 - Projections, ledges, or recesses more than 4 inches shall be beveled not less than 75 degrees.
- 5) Sec. 2.2 - Pit floors shall be approximately level and be provided with a sump for a drain or sump pump and have a sump cover that is flush with the floor. Drains or sump pumps shall remove a minimum of 50 GPM per elevator. Exposed discharge lines shall be of metal. Discharge lines shall be provided with a check valve installed close to the drain or pump. Shut-off valves in discharge lines and oil sensing equipment to stop fluid removal are not allowed.
- 6) Rule 2.2.4 - Access to pits shall be by a ladder extending to at least 48 ins. above the lowest landing or by a separate pit access door, where required. Ladders shall be within reach from the lowest landing door.
- 7) Rule 2.2.5 - Pits shall be provided with a minimum of 10 foot candle lighting with light guard. The light switch shall be located on the pit ladder side and within easy reach from the pit access door.
- 8) Rule 2.2.8 - Where applicable, provide a permanent means to access the underside of the car (i.e.; working platform) if the distance from the pit floor to the underside of the plank channels or slings exceeds 83 inches.
- 9) Rule 2.7.3.4.3 - Where applicable, hoistway access doors of secondary and overhead machinery spaces shall be a minimum of 29 ½ inches in width and height and shall be self-closing and self-locking using a spring-type lock.
- 10) Rule 2.7.3.4.6 - Where applicable, hoistway access doors necessary for access to an MRL elevator emergency brake shall be a maximum of 24 inches in width and height and shall be self-closing and self-locking using a spring-type lock. Keys to unlock the access doors shall be Group 1 Security (restricted to elevator personnel only).
- 11) Rule 2.7.4 - Where applicable, headroom in secondary and overhead machinery spaces shall be a minimum of 42 inches without a governor and 53 inches with a governor.
- 12) Rule 2.8.3.3.4 - If sprinklered, all electrical equipment in the pit within 48 inches above the pit floor shall be weatherproof (NEMA 4 rated) and wiring identified for use in wet locations per NFPA 70.
- 13) Rule 2.4.12 - The minimum vertical distance in the refuge area between the car top and the overhead structure or other obstruction shall not be less than 43 in. when the car has reached maximum upward travel.
- 14) Rule 2.7.9.1 - Where applicable, hoistway machinery spaces shall be provided with a minimum of 19 foot candle lighting with light guard. The light switch shall be located within easy reach of access to such space.
- 15) Rule 2.7.9.2 - Where applicable, hoistway machinery spaces shall be provided with means, mechanical if necessary, to keep the temperature and humidity in the range specified by the elevator equipment manufacturer.
- 16) Rule 2.8.1&2 - Machinery and equipment or electrical equipment and wiring that does not pertain to the elevator is prohibited.
- 17) Rule 2.8.3.3 - Sprinkler protection shall supply only branch lines at not more than one floor level (see drawing). Sprinkler lines running up the hoistway are prohibited. Pit sprinkler heads shall be within 24 inches of the pit floor.
- 18) Rule 2.8.3.3.2 - When sprinklered, a main power shunt-trip disconnect and heat detector(s) is required. Heat detectors shall be within 2 feet of each sprinkler head at the top of the hoistway. No heat detectors in sprinklered pits.
- 19) Rule 2.8.3.4 - Pipes or ducts conveying gases, vapors, or liquids that do not pertain to the elevator are prohibited.
- 20) Rule 2.27.3.2.1 - Provide smoke detector(s) in the top of hoistways that are sprinklered.
- 21) NFPA 70 - 620.23 - Where applicable, secondary and overhead machinery spaces shall be provided with a GFCI protected duplex receptacle. Machinery space lighting (see #14) and receptacle shall be on a separate branch circuit.
- 22) NFPA 70 - 620.24 - Pits shall be provided with a GFCI protected duplex receptacle. A single non-GFCI receptacle shall be provided for the sump pump. Pit lighting and receptacles (see #7 and 12) shall be on a separate branch circuit.

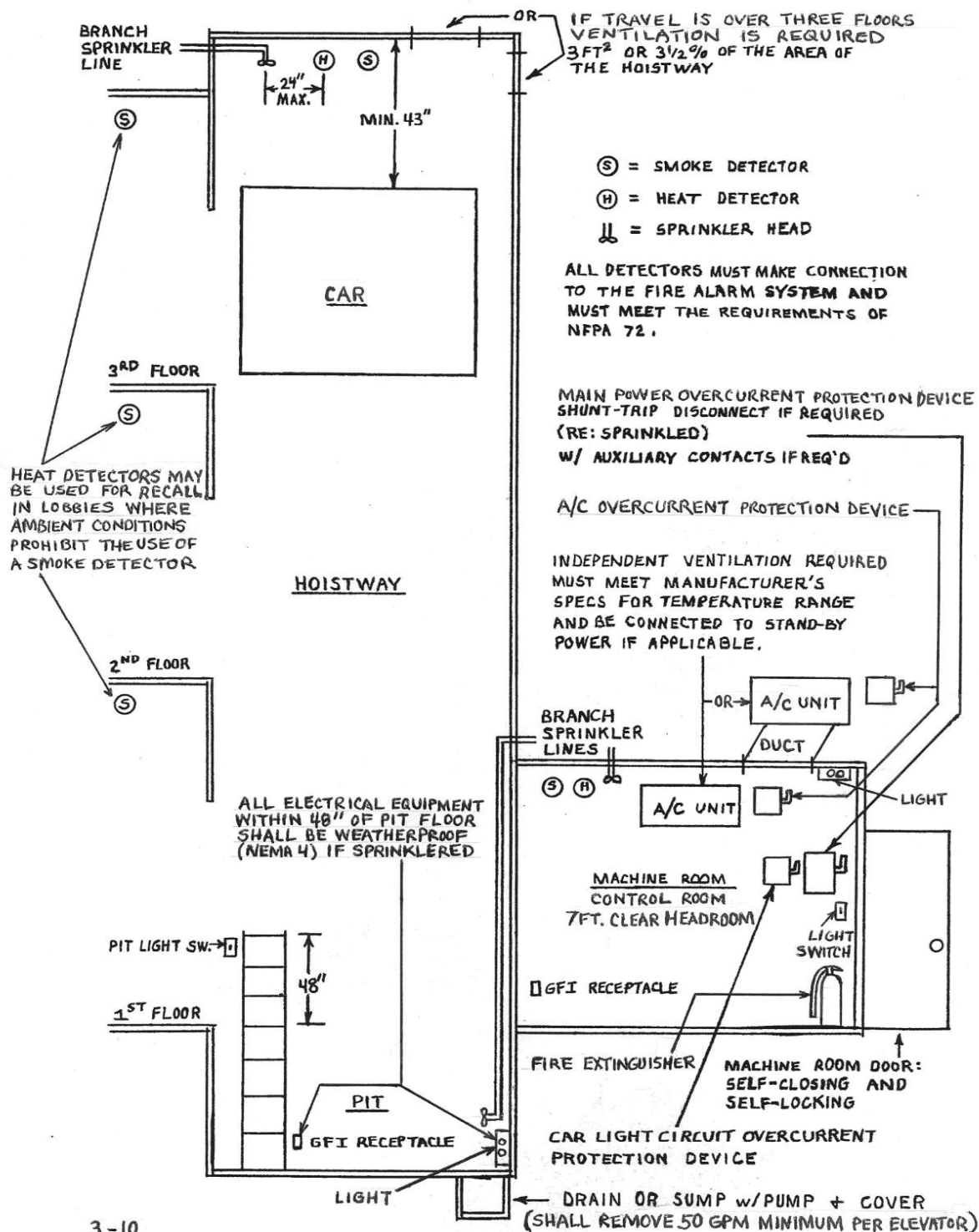
MACHINE ROOM/ CONTROL ROOM/ CONTROL SPACE

pg.2 3-10

- 23) Sec. 2.7 - Provide machine room (control room/control space, if applicable) enclosure conforming to all applicable codes. Fire-resistance rating shall conform to the building code. Seal all gaps and penetrations.
- 24) Rule 2.7.2 - A minimum of 18 inches around equipment for maintenance path and clearance shall be provided.
- 25) Rule 2.7.3.1.1 - Safe, permanent, and unobstructed access to these rooms/spaces shall be provided.
- 26) Rule 2.7.3.3 - Stairs provided for access to or in machine/control rooms or control spaces shall be a minimum of 60 degrees from the horizontal, have handrails, and have a platform, at the access-door sill level. Platform length shall permit full swing of the door plus 2 feet for doors that swing out and platform length for doors that swing in shall be not less than the width of the door. Ships ladders are not acceptable as stairs. OSHA standards if applicable will apply.
- 27) Rule 2.7.3.4 - Access doors to machine rooms, control rooms, and control spaces shall be self-closing and self-locking using a spring-type lock. Doors to machine and control rooms shall be not less than 29 ½" wide and 80" high.
- 28) Rule 2.7.4 - Machine/control rooms shall have a clear headroom of not less than 84 inches. Control spaces, where applicable, shall have a clear headroom of not less than 78 inches or the height of the equipment, whichever is greater.
- 29) Rule 2.7.6 - Machine rooms and control rooms, where provided, shall not be located in the hoistway.
- 30) Rule 2.7.8 - Where applicable, remote machine rooms and / or control rooms of electric elevators shall be provided with a permanent means of communication between the elevator car and remote machine room and / or control room.
- 31) Rule 2.7.9.1 - Machine rooms, control rooms, and control spaces shall be provided with a minimum of 19 foot candle lighting (see #43) with light guard. Light switch shall be within reach from the door and on the lock-jamb side.
- 32) Rule 2.7.9.2 - Machine rooms, control rooms, and control spaces shall be provided with independent ventilation means to keep the air temperature and humidity in the range specified by the elevator equipment manufacturer.
- 33) Rule 2.8.1&2 - Machinery, equipment, electrical equipment, or wiring not pertaining to the elevator is prohibited.
- 34) Rule 2.8.3.3 - Sprinkler protection shall supply only branch lines into the machine/control room or control space.
- 35) Rule 2.8.3.3.2 - When sprinklered, a shunt-trip disconnect for the main power supply and heat detector(s) is required. Heat detector(s) shall be within 2 feet of each sprinkler head in the machine/control room or control space.
- 36) Rule 2.8.3.4 - Pipes or ducts conveying gases, vapors, or liquids that do not pertain to the elevator are prohibited.
- 37) Rule 2.8.3.5 - Pipes (i.e.; sprinkler) or similar equipment that contains liquid shall not be located directly above elevator or electrical equipment. Pipes shall not encroach upon any required clearances.
- 38) Rule 2.8.5 - Air conditioning equipment and condensate drains shall not be installed directly above elevator or electrical equipment. Condensate drain lines shall not be connected directly to sewers. Safe and convenient access for servicing and maintenance of air conditioning equipment shall be provided.
- 39) Rule 2.27.3.2.1 - Smoke detection shall be provided in machine/control rooms and control spaces for fire recall.
- 40) Rule 8.6.1.6.5 - A class "ABC" fire extinguisher shall be provided in machine/control rooms and control spaces.
- 41) NFPA 70-620.21 - All wiring shall be installed in metal conduit, box, or wireway.
- 42) NFPA 70-620.22 - A separate branch circuit shall supply the car lights.
- 43) NFPA 70-620.23 - A separate branch circuit shall supply the machine/control room or control space lighting and receptacle. A duplex GFCI receptacle in the machine/control room or control space shall be provided.
- 44) NFPA 70-620.25 - A separate branch circuit shall supply the machine/control room or control space air conditioning equipment. A disconnect with overcurrent protection and lockable in the open position shall be provided.
- 45) NFPA 70-620.51 - A single means of disconnect, with overcurrent protection and lockable in the open position, shall be provided for the main power supply (see #35). Per NFPA 70-620.91(c) - The main power disconnect shall be provided with an auxiliary contact for use on hydraulic elevators with battery lowering.
- 46) NFPA 70-620.51(d) - All disconnecting means shall be provided with identification and power feed locations.
- 47) NFPA 70-620.53 - A car light disconnect, with overcurrent protection and lockable in the open position, shall be provided in the machine/ control room or control space (see #42).
- 48) IBC-3006.6 - Plumbing systems (i.e.; floor drains) shall not be located in machine/control rooms or spaces.
- 49) NFPA 72-4.4.6. - Fire alarm annunciator panels shall not be installed in elevator machine/control rooms or spaces.

MISCELLANEOUS

- 50) Rule 2.27.1 - Where elevator rise is 60 feet or more, a two-way communications means within the building and accessible to emergency personnel to speak with persons in each elevator car individually shall be provided. Operating instructions shall be incorporated with or adjacent to the two-way communication means outside the elevator car.
- 51) Rule 2.27.3.2.1 - Smoke detectors shall be installed at each floor (lobby) served by the elevator. Heat detectors may be permitted where ambient conditions prohibit the use of a smoke detector (see drawing).
- 52) IBC-3002.4 - Buildings four or more stories above or below grade plane shall be provided with an elevator capable of transporting a 24" by 84" open ambulance stretcher and be identified on the hoistway door frame for such use.
- 53) IBC-3003.1 - In buildings or structures where standby power is required (i.e.; 75 feet of rise or more) or provided for elevator(s), all electrical circuits required for elevator(s) shall be connected to the standby power source.



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ICA/ADOSH-ELEVATOR SECTION – PHOENIX (602) 542-3313, TUCSON (520) 320-4236,4237



ELEVATOR SECTION
FIREFIGHTERS' SERVICE / ELEVATOR SHUTDOWN
GENERAL REQUIREMENTS

(Per ASME A17.1-2000' and NFPA 72-current edition)

General Note:

The following requirements are only a guideline for Firefighters' Service ("elevator recall") and Elevator Shutdown. See the above listed code books for complete requirements. These two operations are separate and work independently of each other. Smoke detectors are used to "recall" an elevator for Firefighters' Service (takes it out of normal service) and heat detectors are used for Elevator Shutdown (main power removal) via the "Shunt-Trip" disconnect.

(A) Fire Alarm Panel requirements:

- 1) The Fire Alarm Panel shall not be located in the elevator machine room.
- 2) The Fire Alarm Panel, or where required - "remote annunciator-fire alarm panel", must be located in an area where an alarm will be readily noticed. If that is not possible, the Fire Alarm Panel, wherever its building location, must be remotely monitored.
- 3) The Fire Alarm Panel and when required - "remote annunciator-fire alarm panel" must identify the type of device activated and its location. Example: "smoke detector - top of elevator shaft (hoistway)"

(B) Detector requirements with no sprinklers in the hoistway or machine room:

- 1) A smoke detector is required in the elevator machine room. Activation of this device shall recall the elevator to the alternate floor, unless the machine room is remotely located, and must cause the "Fire Hat" light in the elevator car station to flash.
- 2) Smoke detectors are required in all enclosed (not open to the outside) elevator lobbies. The detector at the designated (egress) floor level must recall the elevator to the alternate floor and all other lobby detectors must recall the elevator to the designated level.
- 3) No detectors are allowed in the hoistway.

(C) Detector and other requirements with sprinkler in the machine room:

Same requirements as **(B) plus:**

- 1) Heat detector(s) required and shall be located within 24 inches of each sprinkler head. Heat detector(s), when activated, must "Shunt-Trip" the mainline disconnect before the activation of the any sprinkler head.
- 2) If at any time, the power source to operate "Shunt-Trip" is not present, the Fire Alarm Panel and required annunciator panels must indicate a supervisory signal for "loss of elevator shunt-trip power".
- 3) If the mainline disconnect in the machine room is manually turned "off" or its been Shunt-Tripped "off" from a heat detector activation, the Fire Alarm Panel must **NOT** indicate a supervisory signal for "loss of elevator shunt-trip power".

(1)

9-05

cont'd

(D) Detector and other requirements with sprinkler at the top of the hoistway:

Same requirements as (B) number 1) and 2) plus:

- 1) A smoke detector is required at the top of the hoistway. Activation of this device shall recall the elevator to the designated level and must cause the "Fire Hat" light in the elevator car station to flash.
- 2) A heat detector is required at the top of the hoistway within 24 inches of the sprinkler head. Activation of this device must "Shunt-Trip" the mainline disconnect prior to the activation of the sprinkler head.
- 3) All electrical equipment within 48 inches of the pit floor must be weatherproof and NEMA 4 rated (must provide protection from the water spray of a sprinkler head).

(E) Detector and other requirements with sprinkler at the bottom of the hoistway:

Same requirements as (B) number 1) and 2) plus:

- 1) A smoke detector is required at the top of the hoistway. Activation of this device shall recall the elevator to the designated level and must cause the "Fire Hat" light in the elevator car station to flash.
- 2) A heat detector is not required in the pit within 24 inches of the sprinkler head **if** the sprinkler head can be located within 24 inches of the pit floor. If the sprinkler head is over 24 inches above the pit floor, a heat detector will be required, and must meet the weatherproof NEMA 4 rating.
- 3) All electrical equipment within 48 inches of the pit floor must be weatherproof and NEMA 4 rated (must provide protection from the water spray of a sprinkler head).
- 4) A smoke detector is not advisable in the elevator pit (possibility for false alarms).

(F) Firefighters' Service Indication requirements:

- 1) Upon activation of any smoke detectors in any affected elevator spaces, or when the affected elevator Phase I Fire Service recall key switch is turned to the "on" position, an indicator light, on or at, the Phase I Fire Service recall key switch located at the designated level shall illuminate to indicate that the affected elevator(s) is on Firefighters' Service. Activation of any affected elevator lobby smoke detector shall illuminate the "Fire Hat" symbol located inside the elevator. Activation from a hoistway or machine room smoke detector shall illuminate a "flashing Fire Hat" symbol inside the elevator.

(G) Hydraulic Elevator Auxiliary (battery) Lowering with a Shunt-Trip disconnect req's:

- 1) An auxiliary contact on the mainline disconnect must be provided to disable the battery lowering function (elevator cannot move) if the mainline disconnect is manually turned "off" or if it has shunt-tripped "off". Battery lowering can only occur if the normal building power that feeds the mainline disconnect is not present.

(H) Sprinkler Line general requirements:

- 1) Only branch sprinkler lines are allowed in elevator spaces. Branch lines must terminate once they enter a space. Branch sprinkler lines entering the hoistway must enter only from the floor they are to serve. A branch sprinkler line that enters the hoistway at the first landing to sprinkle the pit, can only sprinkle the pit. The branch sprinkler line for the pit cannot extend up to sprinkle the top of the hoistway. That branch line must enter at the top landing. Branch sprinkler lines entering the hoistway at the top floor to sprinkle the top of the hoistway may not extend to other parts of the building. A branch sprinkler line entering the machine room shall only sprinkle the machine room, or it can be allowed to extend to the hoistway only if it will branch sprinkle at that level.

9-05

(2)

THE INDUSTRIAL COMMISSION OF ARIZONA
DIVISION OF OCCUPATIONAL SAFETY & HEALTH
ELEVATOR SECTION
P.O. BOX 19070
PHOENIX, ARIZONA 85005-9070

**REQUIREMENTS FOR ELEVATOR COMPANIES PRIOR TO CALLING
TO CONFIRM ACCEPTANCE INSPECTION**

MACHINE ROOM

Check Box When Completed

- 1) (IBC) Machine room fire rating must match hoistway fire rating
- 2) (IBC) Machine room door fire rating must match hoistway door fire rating
- 3) (A17.1) Machine room door must have the proper lock set and must self close
- 4) (IBC) Penetrations are to be sealed.
- 5) (NFPA & A17.1) An ABC fire extinguisher must be provided
- 6) (A17.1) No foreign electrical conduits may be run through the machine room
- 7) (A17.1) No plumbing allowed other than that required for the machine room A/C unit
- 8) (A17.1) No access panels in the ceiling or roof access hatches are allowed.
- 9) (A17.1) Overhead clearance 7' minimum
- 10) (NFPA) Smoke detector required. Heat detector required within 24" of each sprinkler head
- 11) (A17.1) Shunt trip breaker required if machine room or top of hoistway has a sprinkler
- 12) (A17.1) Shunt breaker must have an auxiliary contact to disable battery lowering, if provided, when the disconnect is either shunted off or turned off.
- 13) (NFPA) Shunt power must be monitored for power loss
- 14) (A17.1 & NFPA) All fire recall and shunt trip devices must be pre tested and panel labels checked for proper description.
- 15) (A17.1) Fire alarm panel is not allowed in the machine room
- 16) (NFPA) If fire alarm panel is not located in an area of general activity a remote annunciator must be in an area of general activity or the panel must have off site monitoring.
- 17) (NFPA) Off site monitoring of fire alarm devices must receive the device identification ie: 'machine room smoke detector Elevator #4'
- 18) (A17.1) PVC conduit or pipe is not allowed in the machine room
- 19) (A17.1) Code data tag required ie: 'built under ASME A17.1-2000 Code'
- 20) (A17.1) Temperature and humidity data tag required
- 21) (IBC) Independent ventilation required. Must not be connected to any other building supply or return.
- 22) (NEC) Machine room ventilation air handler must have a lockable disconnect switch and be on a dedicated circuit.
- 23) (NEC) Machine room lighting and GFCI receptacle must be on a dedicated circuit. Test for circuit separation before inspection.
- 24) (NEC) Car lighting circuit must have a current interrupting, lockable, externally operable disconnect switch.
- 25) (NEC) Car light circuit must be on a dedicated breaker. Test for circuit separation before inspection.

Your signature is necessary to serve as evidence of completion:

NAME _____ TITLE _____ DATE _____
JOB NAME _____
ADDRESS _____

Check Box When Completed

- 26) (NEC) All disconnect switches must have permanent labels noting device being disconnected and panel /breaker number for their power source. Breaker panels must have circuits identified.
- 27) (NEC) Proper electrical clearances per NFPA 70 must be verified. Low voltage (151 VAC on any leg to ground) to any grounded object must have 36" clearance. High voltage (over 151 VAC to ground) must have 42" clearance.
- 28) (NEC) Any Hot device to Hot device must have 48" clearance.
- 29) (A17.1) Emergency brakes (ie: rope grippers, sheave jammers), must be pre tested for empty car up direction unintended motion, 125% full load down direction unintended motion and empty car up direction over speed to insure that they will work correctly during the acceptance inspection.
- 30) (A17.1) Car safeties must be pre tested with rated load at governor jaw trip speed to ensure that the car safeties will stop and hold the car with the correct slide for this overspeed test during during the acceptance inspection.
- 31) (A17.1) All equipment must be properly identified (#1, #2 etc.)
- 32) (A17.1) All machine guards must be in place.
- 33) (A17.1) If seismic is required, all required anchors, rope retainers etc. must be in place.

PIT

- 1) (A17.1) Pit ladder must extend to 48" above the landing with handhold across the top. Pit ladder must be within 39" on a horizontal plane of the hoistway door release mechanism. Pit light and pit switch must be on the side that the ladder is on and be within easy reach from the hoistway entrance.
- 2) (A17.1) Second pit switch is required if the pit is over 67" deep.
- 3) (NEC) Pit light and GFCI receptacle must be on a dedicated circuit. Test for circuit separation before inspection.
- 4) (NEC) Duplex GFCI receptacle must be provided.
- 5) (NEC) Simplex non GFCI receptacle for the sump pump must be provided. This may be on the pit light/receptacle dedicated circuit or on it's own dedicated circuit. Test to ensure that it is not fed from the load side of the pit GFCI if on the same circuit.
- 6) (NEC & A17.1) If the hoistway is sprinkled , than all electrical conduits, boxes etc. must be NEMA 4 rated within 48" of the pit floor. Sump pump receptacle must have a cover that allows the cord to be plugged in and the cover closed.
- 7) (NFPA) If the pit has a sprinkler that is within 24" of the pit floor no fire alarm device is required in the pit.
- 8) (A17.1) A sump pump with a cover flush with the pit floor is required. The cover must be substantial enough to support a person's weight. Backflow prevention is required. A shutoff valve is not allowed in the discharge line. In lieu of a sump pump, a drain with backflow prevention is allowed.
- 9) (A17.1) The pit sump pump must be tested to ensure that it will keep up with the flow of water from a 3/4" hose.
- 10) (AHJ) No PVC conduit or piping is allowed in the pit.

Your signature is necessary to serve as evidence of completion:		
NAME _____	TITLE _____	DATE _____
JOB NAME _____		
ADDRESS _____		

Check Box When Completed

- 11) (A17.1) No oil sensors /separators are allowed in the elevator pit to prevent the sump pump from activating.
- 12) ***** As a courtesy to the building owner, if an oil separator is provided outside the pit have the contractor check that the separator is sized at least as large as the sump pump discharge capacity.
- 13) (A17.1) Pit lighting must be a minimum of 10 foot candles at all points of the pit floor.
- 14) (A17.1) Counterweight guards if required must extend from the lowest part of the counterweight when it's fully compressed buffer to a point not less than 83" and not more than 96" above the pit floor.
- 15) (A17.1) Counterweight guards must be permanently labeled with the designed minimum counterweight runby.
- 16) (A17.1) If seismic is required, hydraulic over speed rupture valves must be provided on hydraulic elevators, properly located and pre tested.
- 17) (A17.1) If seismic is required provide required hydraulic feed line support spacing.
- 18) (A17.1) For a hydraulic elevator, verify that when the elevator is resting on it's fully compressed buffer that the hydraulic piston still has over travel available.
- 19) (A17.1) All hydraulic oil collection containers must be in place and all covers must be installed.
- 20) (A17.1) All hydraulic piston to platen head retainer bolts must be safety wired.
- 21) (IBC) Any conduit or pipe penetrations must be sealed.
- 22) (A17.1) Bottom floor hoistway access key switch if required must be pre tested. The bottom of the car platform apron should be level with the bottom of the hoistway door head jamb when the car is on the access upper limit.

HOISTWAY

- 1) (IBC) Venting required if over three floors. Verify that vent is equal to at least 3 ½ % of the area of the hoistway or 3 square feet, whichever is larger.
- 2) (IBC) All penetrations are to be sealed.
- 3) (IBC) All hoistway doors are to be sealed around door jambs and headers.
- 4) (A17.1) All ledges over 4" are to be beveled
- 5) (A17.1) No foreign piping or wiring is allowed in the hoistway.
- 6) (A17.1) Electrical feeders may not be run through the hoistway.
- 7) (A17.1) Fire alarm device wiring and conduits may not be run through the hoistway except to devices in the hoistway.
- 8) (NFPA) If the hoistway is sprinkled a smoke detector is required at the top of the hoistway. If sprinkled at the top a heat detector is required within 24" of the sprinkler head.
- 9) (NFPA) If the hoistway has beam pockets over 12" deep a smoke detector if required must be on the ceiling in each beam pocket.
- 10) (NFPA) Sprinklers if required must penetrate the hoistway only at the floor being sprinkled.
- 11) Sprinklers must only branch into the hoistway. They cannot then go out to another place in the building.

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ADDRESS _____		

Check Box When Completed

- 12) (A17.1) All hoistway door retainers must be in place.
- 12) (A17.1) All hoistway doors must be numbered.
- 13) (A17.1) If seismic is required, all safety retaining devices and counterweight displacement devices must be installed and tested.
- 14) (A17.1) If elevator is the MRL type, a work light with bulb protection, a light switch on a dedicated circuit, and a stop switch must be provide in the vicinity of the drive machine.
- 15) (A17.1) If elevator is the MRL type and an access panel is provide for the brake release mechanism, this panel must have a self closing and self locking door with Group 2 security, a light switch for the work light located in the vicinity of the drive machine and have expanded metal on the inside of the hoistway to prevent reaching into the hoistway through this panel.
- 16) (A17.1) Top floor access switches must be provide if the distance from the top landing to the top of the car is over 35" when the car is level with the landing directly below the top landing.
- 17) (A17.1) Temperature and humidity data tags shall be provided on equipment located in the hoistway for MRL elevators.
- 18) (A17.1) Means to maintain manufacturer's recommended temperature and humidity in the hoistway of MRL elevators shall be provided and it must be independent of other building supplies and returns.
- 19) (A17.1) Terminal limit switches must be pre tested to ensure they operate properly and are properly located.
- 20) (A17.1) Glass in hoistways shall meet the requirements of ANSI Z97.1 or CFR Part 1201 and must be laminated. Each piece must be permanently and legibly marked (ie., ANSI Z97.1, CFR Part 1201 Laminated)

CAR (all items on this page A17.1)

- 1) Cartop railing must be installed if clearance to the hoistway exceeds 12"
- 2) Cartop work lights must have bulb protection.
- 3) Emergency exit must be locked and electrical contact working.
- 4) Door operator closing speed data tags must be provided and completed.
- 5) Hoist and governor data tags must be installed and completed.
- 6) Hoist rope anti rotation devices must be installed.
- 7) Telephones must be working properly.
- 8) Alarm and emergency lighting must be working.
- 9) Car flooring must be installed to eliminate a tripping hazard.
- 10) Car door closing speed must be within the parameters set by the door operator data tag.
- 11) Ceiling panels must be in place.
- 12) Capacity plates must be installed.
- 13) Car and counterweight safety data plates must be installed.
- 14) Car door restrictor devices must be working.
- 15) Car enclosures constructed of glass panels must be laminated and meet the requirements of CFR Part 1201, Sections 1201.1 and 1202. Each panel must be permanently and legibly marked (ie: CFR Part 1201, Section 1201.1, 1202 Laminated)

Your signature is necessary to serve as evidence of completion:

NAME _____ TITLE _____ DATE _____
 JOB NAME _____
 ADDRESS _____

Check Box When Completed

- 16) Glass used for lining cab walls or ceilings shall be laminated or may be tempered glass provided that it conforms to ANSI Z97.1, 16 CFR Part 1201, Sections 1201.1 and 1201.2. and the glass is bonded to a nonpolymeric coating, sheeting, or film backing having a physical integrity to hold the fragments when the glass breaks and the glass is tested and conforms to the acceptance criteria for laminated glass as specified in ANSI Z 97.1, or CFR Part 1201, section 1201.4. Each piece shall be permanently and legibly marked, (ie., ANSI Z97.1, CFR Part 1201, Sections 1201.1 and 1202 Tempered).

GENERAL REQUIREMENTS

- 1) Lobby flooring must be flush with hoistway sills to eliminate trip hazards.
- 2) Standby power if supplied to a common car group must have all cars in that group supplied with standby power.
- 3) If all elevators in a group supplied with standby power cannot be run simultaneously than a selection switch must be provided in sight of the elevator group at the designated level.
- 4) Standby power selection switches must be keyed the same as fire service (AZFS)
- 5) If all elevators in a group can be run on standby power, than the standby power source must be tested with all elevators running at the same time with rated load.
- 6) All lighting circuits, air conditioning circuits, etc. feeding the elevator must continue to be powered while on standby power.
- 7) Lobby ceilings must be in place with smoke detectors attached to the completed ceilings.
- 8) Flexible hydraulic lines may not penetrate a wall or be in the hoistway
- 9) All new technology ropes not meeting the prescriptive code must have rope maintenance guidelines on the jobsite and must remain in the machine or control room.
- 10) Written guidelines for the performance of all required Acceptance and Periodic tests must be maintained in the machine room or control room.
- 11) Multiple elevators in a building must be identified at the designated level and inside each elevator.
- 12) Fire service key switches must be AZFS

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NAME _____	TITLE _____	DATE _____
JOB NAME _____		
ADDRESS _____		

ANY OF THESE ITEMS FOUND NOT TO HAVE BEEN CHECKED PRIOR TO CONFIRMING A SCHEDULED ACCEPTANCE INSPECTION IS CAUSE FOR THE INSPECTOR TO LEAVE THE JOBSITE AND A REINSPECTION TO HAVE TO BE SCHEDULED.

ALL OF THESE ITEMS MUST BE CONFIRMED TO BE COMPLETED PRIOR TO CALLING TO CONFIRM THE INSPECTION.

FAX OR E-MAIL THIS COMPLETED FORM TO OUR OFFICE AS PART OF THE CONFIRMATION PROCESS

<p>Phoenix: (602) 542-3313 (main #) (602) 642-1642 (fax #) ksturtevant@ica.state.az.us j.sargent@ica.state.az.us TStoltz@ica.state.az.us</p>	<p>Tucson: (520) 325-3192 (fax #) Respective Inspector: Don Jimenez: (520) 320-4237 / (520) 404-9266 / DJimenez@ica.state.az.us Bill Eley: (520) 320-4247 / (520) 404-9267 / welev@ica.state.az.us Galen Williams: (520) 320-4248 / (520) 870-7739 / GWilliams@ica.state.az.us</p>
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End of Section 14 00 00

DIVISION 14 - CONVEYING EQUIPMENT

Section 14 21 00 - Electric Traction Elevators

WORK INCLUDED

- Installation of a new engineered TRACTION elevator complete as described in this standard.
- Elevator systems shall be engineered in accordance with the requirements within this document.

SUBMITTALS

- Submit bound operation and maintenance manuals for the new equipment (4 copies) with operating and maintenance instructions, parts listing, recommend parts inventory listing, purchase source, listing for critical component, emergency instructions, complete "as built" wiring and block diagrams including input signals, and diagnostic and/or trouble-shooting guide shall be furnished to the Owner.
- Submit a complete list of all items to be furnished and installed under this section. Included manufacturer's specifications, catalog cuts, and other data to demonstrate compliance with the specified requirements.
- Submit complete shop drawings for all work in this section, showing dimensions and locations of all items including supporting structure and clearances required.
- Manufacturer's recommended installation procedures which, when approved by the Owner, shall be the basis for inspecting and accepting or rejecting actual installation procedures used on the work.
- Submit two (2) complete clean set of drawing prints and specifications with "as-built" conditions marked in crisp red ink. Sign and attest to the documents as reflecting all conditions "as-built".
- Provide two (2) copies of Operation and Maintenance Manuals, Installation Manuals and Parts Manual necessary for full servicing of the elevator and microprocessor.
- Provide one (1) digital copies on "CD" of "AS-BUILT" wiring drawings and O&M Manuals.

QUALITY ASSURANCE

- Elevator installer is responsible for quality assurance and insuring that all systems related to the function of the elevator are complete and functioning properly.

MAINTENANCE

- Starting at the time of substantial completion of the complete project, provide complete systematic inspection and maintenance of the elevator for a period of 12 months. Furnish trained experts and equipment to check, adjust, lubricate, and otherwise maintain the elevator in operation without defects or deterioration. Replace or repair materials and parts that become defective or deteriorated for any reason except through abuse or misuse by Owner.

USE OF ELEVATOR

- The elevator shall not be used temporarily for building construction purposes unless specifically allowed by the Owner.

- If the Contractor is allowed to use the elevator prior to Substantial Completion of the project, the warranty and service period shall not be comprised and shall begin when substantial completion is achieved.

ENGINEERED TRACTION ELEVATOR

- Acceptable elevator manufacturers are:
 - Kone Elevator Company
 - Otis Elevator Company
 - Schindler Elevator Company
 - Thyssen Krupp
 - Arizona Elevator Solutions
- Attributes (**Traction Elevator**)
 - Capacity: TBD
 - Speed: TBD
 - Operation: Selective collective.
 - Control: Microprocessor based Motion Control Engineering 4000 regenerative controller AC motor drive.
 - Travel: TBD
 - Stops: TBD
 - Openings: TBD
 - Platform size: TBD
 - Clear inside car: TBD
 - Car Doors: TBD
 - Hoist way entrance: TBD
 - Hoist way entrance finish: TBD
 - Door Operation: G.A.L. MOVFR System
 - Landing system with MCE ELGO Absolute Positioning System
 - Hollister-Whitney rope gripper
 - Safety plank type B
 - Hollister-Whitney Governor, tail sheave, and rope
 - Signals: Illuminated car and hall operating buttons, illuminated by light emitting diodes. Tamper Proof. SUVIVOR PLUS by Elevator Products Corporation. (EPCO) EPCO fixtures preferred; Innovation Bruiser Series approved alternate.
 - Provide emergency access in all hoist way entrances.
 - Photo curtain shall be model A850G7 Gatekeeper 2000 by Adams Elevator Equipment Co.
 - Car telephone shall be model no. A936P3-2 as manufactured by Adams Elevator Co.
 - Two-way voice communication within the building for emergency personnel in elevators with a 60ft or more rise (RATH Microtech)
 - Capable of emergency power switching and operation
 - Car Enclosure:
 - Control panel (hinged to swivel toward the wall for easy access) complete with the following:
 - Digital car position and direction indicator, illuminated with light emitting diodes.
 - Fan key switch (Keyed to an EPCO-1).
 - Emergency stop key switch (Keyed to an EPCO-1).
 - Independent service key switch (Keyed to an EPCO-1).
 - Inspection/access key switch (Keyed to an EPCO-2).

- Fire-fighter service key switch (Keyed to AZFS).
 - COP Maintenance panel (Keyed to Northeast J200)
 - Alarm bell push type switch.
 - Engraved capacity plate and elevator designation. Verify fabrication.
 - Engrave "INSPECTION CERTIFICATE ON FILE AT FACILITIES O"
 - Light key switch (Keyed to an EPCO-1).
 - Emergency light located in car control panel.
 - Emergency light test button.
-
- The car platform shall be provided with vinyl composition tile flooring. Color as selected by Owner.
 - All elevators that are subject to high material or equipment transport use or other extreme uses (i.e., heavy loading, wheeled carts, exterior opening) shall have aluminum diamond plate floors.
 - For elevators that open to the exterior of a building the area surrounding the elevator entrance should be sufficiently sloped away from the entrance to prevent water from entering into the elevator hoist way.
 - Suspended egg crate ceiling with baked enamel finish or aluminum frame.
 - Lighting: Cool white T-8 fluorescent lighting.
 - Handrails: Stainless Steel.
 - Sill: Aluminum.
 - Ventilation: Exhaust type, single speed squirrel cage, 300 CFM velocity exhaust blower. Isolate blower from steel cab canopy with rubber grommets.
 - Provide hooks and removable blanket for protection of cab interior.
 - Transom: Stainless steel.
 - For elevators with glass installed in the cab or hoist way each piece of glass shall be laminated glass conforming to ANSI Z97.1 or 16 CFR Part 1201 with respective markings on each piece of glass clearly and permanently visible after installation.
- Elevator shall have provisions for ADA complying with the requirements of ANSI A117.1 and new ADAAG Guidelines.
 - Furnish manufacturers standard three roller guide assemblies with spring tension and adjustable rollers. T-rails with all required mounting hardware required for mounting.

ENVIRONMENTAL CONSIDERATIONS

- Ambient temperature: 32 F to 104 F (0 C to 40 C).
- Humidity: not over 95% humidity.

OPERATION, EQUIPMENT AND FUNCTION

Controller: Solid State Motion Control Engineering 4000 regenerative controller AC Motor Drive for traction elevators.

- The elevator controller shall be microprocessor based and designed specifically for elevator applications. Elevator and drive logic shall be implemented independently of safety functions.
- Elevator logic shall be implemented on a single processor to facilitate tight coordination between subsystems and enhance reliability. The implementation shall utilize a real-time, multi-tasking operating system to allow the processor to simultaneously execute elevator control logic, drive control logic, operator interface logic, and communication support.

- The elevator controller shall provide the ability to access significant memory capacity for configuration parameter storage, event recording, real-time diagnostics, and program execution.
- The elevator controller shall have an independent safety system in order to implement safety features required by code. The safety system implementation shall utilize solid-state devices. No relays shall be used for safety logic. The safety subsystem shall incorporate a check redundant, dual-processor, dual-path, solid-state, ASME A17.1-2000 compliant implementation that meets CSA and CE standards.
- The elevator controller shall be configured and packaged in such a way that external “jumpers” cannot be used (intentionally or unintentionally) while the elevator is running in any passenger mode of operation. Non-passenger modes of operation shall be provided, along with means to bypass safety functionality, to allow inspection testing and other setup and/or troubleshooting operations.
- The elevator control logic configuration shall be fully field programmable. Changes in number of floors, I/O configuration, drive setup, eligibility etc. shall not require the replacement/reprogramming of EEPROMs or other storage devices. Further, changes in the controller configuration shall be user adjustable in the field.
- The elevator controller shall have extensive diagnostic capability. A built-in LCD display or equivalent shall allow access to major user functions and diagnostic features. The display shall be a multi-character, multi-line type with associated keypad to allow users to enter information. The display shall show data and menus in readily understood character format. No numeric, hexadecimal, or binary codes are acceptable.
- Dedicated indicators shall be provided in a conspicuous location on the elevator controller to indicate important system statuses, such as when the safety string is closed, when the door locks are closed, when the elevator is on Inspection/Access, etc. In addition, other special or error conditions detected by the main processor or safety subsystem shall be displayed.
- The elevator controller shall support an interface for communication and interaction via a separate application program running on a Windows PC. This application shall communicate with the controller and allow the user to access controller configuration parameters, view real-time elevator status information, initiate and facilitate setup and adjustment procedures, and provide advanced troubleshooting capabilities. The PC application shall be designed specifically for elevator applications and shall graphically and dynamically display information from the controller.
- A PC application shall provide facilities to manage elevator controller configuration parameters. The user shall be able to manage and manipulate parameters including:
 - Retrieve from the elevator controller and view/edit
 - Retrieve from the elevator controller and save to a file on the PC
 - Retrieve from the PC, view/edit, and download to the elevator controller
 - Manage separate configurations for multiple elevator controllers
- The user shall be able to select specific groups or subsets of parameters to send or retrieve from the elevator controller.
- A PC application display shall provide motor field (where applicable), armature and brake voltages, armature current, intended and actual car speeds and hoist machine RPM. The PC diagnostics and adjustment display shall include online context-sensitive parameter descriptions and help information for fault troubleshooting.
- The controller shall maintain an event log that records noteworthy events or faults. They shall be displayed in chronological order and time stamped for analysis or review. Data displayed shall include the

- type of event or fault, the date and time it occurred, and the position of the car and status of various flags at the time of the occurrence. The event log shall be able to be saved and reviewed offline via the PC application.
- Communication between the elevator controller and the PC application shall be via a standard 100 base T TCP/IP network connection. The elevator controller shall be compatible with standard networking equipment (cables, hubs, switches, routers and etc).
 - A PC application and elevator controller shall support remote connection via the internet (if available). The elevator controller shall support up to four simultaneous PC connections (remote and/or local). A mechanism shall be provided to prevent the unauthorized alteration of elevator configuration parameters.
 - A controller test switch shall be provided. In the test position, this switch shall enable independent operation of the elevator, with the door open function deactivated, for purposes of adjustment and testing. The elevator shall not respond to hall calls and shall not interfere with any other car in a duplex or group installation.
 - Switches for controller inspection, enable, and up and down shall be provided to place the elevator on Inspection operation and allow the user to move the car from the machine room. The car top inspection switch shall render the controller inspection switch inoperative.
 - The elevator control and safety functions shall be part of an integrated system designed for ease of use, with diagnostics and parameter adjustments accessible through a common user interface.
 - The brake supply shall be capable of providing at least four independently adjustable values of output voltage in order to provide smooth lifting, holding and releveling. These values shall be adjusted via computer parameters. Manual adjustment of resistor values shall not be required.
 - The elevator controller shall provide auto-tuning of the brake control values.
 - The controller shall provide logic to detect a failure of brake voltage to properly decay and relax a picked brake to hold/cooling position.
 - The brake control system shall include circuitry to detect insufficient brake current. This failure shall cause the elevator to be removed from service at the next stop and remain out of service until the condition is corrected.
 - For gearless applications, the drive control system shall use an optimized speed profile in a dual-nested-loop feedback system based on car position and speed. A speed feedback device (tachometer or encoder) shall permit continuous comparison of motor speed with the calculated speed profile to provide accurate control of acceleration and deceleration right up to and including the final stop, regardless of direction of travel or load in the car. Drive subsystem control parameters shall be digitally adjustable through software and shall be stored in non-volatile FLASH memory.
 - For DC applications, the system shall include precise closed-loop motor field control. The system shall regulate motor field current throughout the range of operation via current feedback from the motor field. The system shall provide motor field current sensing which shall shut down the elevator if insufficient motor field current is detected.
 - The system shall provide adaptive gain parameters for optimum control of elevator speed throughout its travel.

- The system shall use a device to establish car position to an accuracy of 0.1875" (4.76 mm) or better, using a quadrature signal operating over the entire length of the hoist way.
- The system shall use an automatic two-way leveling device to control the leveling of the car to within 0.25" (6.35 mm) or better above or below the landing sill. Over travel, under travel, or rope stretch shall be compensated for and the car brought level to the landing.
- A system for pre-torquing the hoist motor shall be made available to ensure consistently smooth starts. An electronic load sensor shall be required to implement the pre-torquing feature.
- Pre-start sequencing shall be provided to safely energize the machine prior to the doors closing on a departing elevator, thus consistently improving floor-to-floor travel times.
- Door pre-opening as the car approaches a landing shall be field adjustable to begin a maximum of six inches from level-at-floor position.

AC Motor Drive

- The control system shall utilize an AC motor drive.
- The AC motor drive shall be capable of producing full torque at zero speed and shall not require DC injection braking in order to control car deceleration.
- The drive shall be capable of controlling geared and gearless machines, induction and permanent magnet motors. The drive shall also work with different types of encoders such as incremental, sine/cosine, and Hiperface.
- The drive shall have built-in motor overload protection. External overload is not required.
- The drive shall have the capability of being adjusted or programmed to achieve the required motor voltage, current, and frequency to properly match the characteristics of the AC elevator hoist motor.
- The drive shall not create excessive audible noise from the elevator motor.
- The drive shall be heavy-duty, capable of delivering sufficient current required to accelerate the elevator to contract speed with rated load. The drive shall provide speed regulation appropriate to the motor type.
- For non-regenerative drives, means shall be provided to remove regenerated power from the drive DC power supply during dynamic braking. This power shall be dissipated in a resistor bank that is an integral part of the controller. Failure of the system to remove regenerated power shall cause the drive output to be removed from the hoist motor.
- A regenerative drive option (PowerBack) is available to return power to the AC line during dynamic braking. This system is very effective for higher horsepower (above 30HP) and gearless applications.
- A contactor shall be used to disconnect the hoist motor from the output of the drive unit each time the elevator stops. This contactor shall be monitored and the elevator shall not start again if the contactor has not returned to the de-energized position when the elevator stops.
- The controller shall provide step less acceleration and deceleration and provide smooth operation at all speeds.

- For applications where the building power supply has a “Grounded Leg Delta” configuration, an isolation transformer should be used to minimize noise and prevent any damage to the drive during voltage fluctuations.

Monitoring

- A PC-based system monitoring application shall be available. At a minimum, monitoring shall be capable of providing system status, car location and travel direction, operating mode, door operation indication, dispatching ETAs, and security status.
- The monitoring system shall be capable of remotely registering car and hall calls and of configuring hall call and car call restrictions in support of building security. The system shall be capable of implementing security overrides if required.
- The monitoring system shall be capable of enabling Swing, Sabbath, and Auto-stop modes of operation on the group control and of acknowledging emergency alarm activity on any car in the group.
- The monitoring system shall be capable of selecting group mode of operation including, Balanced, Lobby Peak, Demand Down, Demand Up, and Auto-mode (dynamic mode selection by group controller) when Operating Mode Configuration 1 is active on the group.
- The monitoring system shall be capable of setting the group to Flood Operation mode when such mode is supported by the group control.
- The monitoring system shall be capable of initiating recall of any car in the group to a selected floor and of controlling door operation of that car at the selected floor.

Reporting

- A client/server based report collection and generation application shall be available. Based on historical data collected by the server, the report application shall provide, at a minimum, hall call performance, hall call analysis, traffic analysis, hall call log, car call log, event log, emergency log, maintenance log, and percent in service reports.
- Systems that require hook-up of external devices for trouble-shooting are not acceptable.
- Nudging: If the doors shall be prevented from closing for longer than a predetermined time, door nudging operation shall the doors to move at slow speed in the close direction and to be unresponsive to the photo curtain. A buzzer shall sound while nudging operation is active.
- Hall or car call registration and lamp acknowledgment shall be by means of a single wire per call besides the power busses. Systems that register the call with one wire and light the call acknowledgment lamp with a separate wire are not acceptable.
- Fireman's Phase I emergency recall operation, alternate level Phase I emergency recall operation, and Phase II emergency in-car operation shall be provided according to applicable local codes. Keyed (AZFS)
- Independent service operation shall be provided such that the actuation of a key switch in the car-operating panel will cancel any existing car calls, and hold the doors open at the landing. The car will then respond only to car calls and will ignore hall calls. Car and hoist way doors will only close by constant pressure on car call buttons or a door close button until the car starts to move. While on independent service, hall arrival lanterns or jamb mounted arrival lanterns and gongs shall be inoperative. Keyed (EPCO-1)

- Simplex selective collective automatic operation shall be provided for all single car installations. Operation of one or more car or hall call buttons shall cause the car to start and run automatically provided the hoist way door interlocks and car door contacts are closed. The car shall stop at the first car or hall call set for the direction of travel. Stops shall be made in the order in which the car or hall calls set for the direction of travel are reached, irrespective of the order in which they were registered. If only hall calls are set for the opposite direction of travel exist ahead of the car, the car shall proceed to the most distant hall call, reverse direction, and start collecting the calls. For multiple car installations use duplex, triplex, etc.
- A test switch shall be provided. In the "test" position, this switch shall allow independent operation of the elevator without the door open function for purposes of adjustment or testing the elevator. The elevator shall not respond to hall calls shall not interfere with the other car in a duplex installation.
- A timer shall be provided to limit the amount of time a car is held at a floor due to a defective hall call or car call including stuck push buttons. Call demand at another floor shall cause the car to eventually ignore the defective call and continue to provide service in the building.

Emergency Recall Operation

- Elevators shall be arranged to operate in accordance with ASME A17.1 Rule 211.3. Provide Phase I emergency recall switch for each group of elevators. Locate key switch at second floor or main egress landing.

Geared Machine

- Hollister-Whitney Basement or Overhead Traction Machine
- Provide new AC reversible type, foot mounted hoist motor particularly designed for elevator service with a high starting torque (minimum 200% of rated torque) and a low starting current.
- The motor and controller shall have sufficient horsepower to drive the elevator under full load conditions and operate at a minimum 200 starts per hour without overstressing motor.

Governor

- Provide new centrifugal governor that will operate the car safeties should the elevator exceed 120% of contract speed in the down direction. Provide governor with a new rope.

Governor Ropes

- Provide traction steel governor ropes of sufficient size and number to ensure proper traction qualities. Governor ropes provided for any car shall be from same factory production run and shall be suitably protected against rust and corrosion.
- Properly secure governor ropes at both ends.
- Provide dated rope installation tag at car end of governor ropes.

Unintended Motion

- Hollister-Whitney Rope gripper with engineered bracket.

- Provide new rope brake gripper designed to meet codes for unintended motion in either the upwards or downward direction of travel.

Safety Device

- Provide new flexible guide car safety devices mounted on underside of the platform. Perform the necessary test as required code upon the completion of the project.

Car and Counterweight Guides

- Provide roller guides and assemblies consisting of spring-loaded tired wheels of a durable, resilient material maintained in uniform contact with three-finished rail surfaces and operate on dry UN-lubricated rail surfaces. Use polyurethane or other roller tire material, which will not develop flat spots after standing idle for 24 hours under average conditions. Provide the maximum car roller guide diameter as possible, given the tight rails and bracket clearances. ELSCO 6" model B shall be provided for the car and ELSCO 3" Model D for the counterweight.
- Statically balance car and counterweight so that minimum amount of pressure is required to center the safety throat in the rails and provides for the best ride quality.

Door Equipment

- Heavy Duty G.A.L. MOVFR Door Operating System to include, G.A.L. door rollers, door hanger tracks (car and hall) door pick-up assemblies, gate switch, door locks.
- Provide emergency access in all hoist way doors.
- All doors shall have 1-1/2 hr. label or other identification acceptable to governing authorities.
- Provide adjustable nylon guide (by Nylube or Adams Elevator Equip. Co.).
- Heavy-duty doors. Provide door skins on both sides of elevator doors.

Lobby Position Indicator

- Provide tamper resistant lobby position indicator on the ground level, illuminated by light emitting diodes. By Elevator Products Co. (EPCO)

Smoke Detectors

- Smoke and heat detectors shall be compatible and tie into building fire system. NOTE: Heat detectors for activation of shunt trip devices do not need to report to fire alarm system.

Hall Direction Indicator

- Up and down tamper resistant SURVIVOR PLUS as manufactured by Elevator Products Co. (EPCO). Direction indicators to be provided in the hall wall with a single chime or tone for up and double chime or tone for down direction and shall be illuminated by light emitting diode.

Photo Curtain

- Photo Curtain: An electric, passenger-sensing device of the photo curtain shall project across the entrance to prevent the car and hoist way doors from closing if a passenger or object interrupts the curtain.
- Nudging: If the doors are prevented from closing for longer than a predetermined time, door-nudging operation shall cause the doors to move at a slow speed in the closed direction and to be unresponsive to the photo curtain. A buzzer shall sound while nudging operation is occurring.

Car Operating Station

- Flush mounted operating panel shall be mounted in the car return panel and shall contain the devices required for the specified operation. The buttons and devices shall be of the easy readability type and the floor designation buttons shall become illuminated when pressed and shall stay illuminated until the floor call is answered. Provide continuous hinge on panel for easy access to internal components. Locate hinges on side of panel nearest wall of the elevator. The car operating shall contain the floor designations, and all the controls indicated.
 - Digital car position indicator, illuminated with light emitting diodes.
 - Fan key switch (Keyed to an EPCO-1).
 - Emergency stop key switch (Keyed to an EPCO-1).
 - Independent service key switch (Keyed to an EPCO-1).
 - Inspection/access key switch (Keyed to an EPCO-2).
 - Firefighter service key switch (Keyed to AZFS).
 - COP Maintenance panel (Keyed to Northeast J200).
 - Alarm bell push type switch.
 - Light key switch (Keyed to an EPCO-1).
 - Engrave capacity and elevator designation.
 - Engrave "INSPECTION CERTIFICATE ON FILE AT FACILITIES MANAGEMENT"
 - Emergency light.
 - Emergency light test button.

Elevator Shutdown

- Elevator power shall automatically shut down prior to sprinkler activation. This is typically accomplished by the use of a shunt trip breaker activated by a heat detector.
- Heat detector to be located no more than 24" from any fire sprinkler head installed in elevator shaft or machine room.
- Heat detector should also report to fire alarm system.
- Conduit circuits to shut down elevator power shall be monitored and supervised by the Fire Alarm System.

EXECUTION

Telecommunication Link

- Install communication cable for controller modem not to exceed 24" from controller.
- Install communication cable for car phone not to exceed 24" from controller.

Adjust and Balance

- Make necessary adjustments of equipment to ensure elevator operates smoothly and accurately.

Protection

- Locate and protect movable equipment and controls in such a way that authorized persons can only operate them.

Inspections

- Obtain and pay for inspections and permits and make sure test are as required by regulations of authorities. Conduct all tests and inspections in the presence of the Owner.
- Final inspection shall be after all new equipment is installed and operating correctly.
- Inspect installation in accordance with ANSI-A17.2.
- Deliver test certificates and permits to Owner.

Operation and Maintenance

- Instruct Owner's personnel in proper use, operations and daily maintenance of elevators.
- Training shall include operation of diagnostic microcomputer and servicing of elevator microprocessor.
- Make final check of each elevator operation, with Owner's personnel present and just prior to date of substantial completion. Determine that control systems and operating devices are functioning properly.
- Continuing Maintenance: Provide 1-year maintenance on elevators on an as-needed basis as part of standard 1-year warranty on new equipment and upgrades.
- Maintenance shall include systematic examination, adjustment and lubrication of new elevator equipment; replacement of seals, packing and valves to maintain required factor of safety; performance of maintenance work without removing car during peak traffic periods and providing 24 hour emergency call back service during maintenance period, at an additional cost to Owner.
- Repair or replace electrical and mechanical parts of the new elevator equipment using only genuine standard parts produced by manufacturer of equipment concerned.
- Ensure that competent personnel handle maintenance service. Maintain and adequate stock of parts for replacement of emergency purposes, locally, and have qualified personnel available at such places to ensure the fulfillment of this service without unreasonable loss of time.

Cleaning

- Remove all trash and debris from site during elevator installation.
- Clean all elevator surfaces, removing all dirt, dust, spots, and scratches. Any damage shall be repaired or replaced as directed by Owner, at no cost to Owner.
- Prior to substantial completion, remove protection from finished or ornamental surfaces and clean and polish surfaces with due regard to type of material.
- Remove tools, equipment and surplus materials from site.

End of Section 14 21 00

DIVISION 14 - CONVEYING EQUIPMENT

Section 14 24 00 - Hydraulic Elevators

WORK INCLUDED

- Installation of a new-engineered HYDRAULIC elevator complete as described in this standard.
- Provide an engineered system in accordance with this document.

SUBMITTALS

- Submit bound operation and maintenance manuals for the new equipment (4 copies) with operating and maintenance instructions, parts listing, recommend parts inventory listing, purchase source, listing for critical component, emergency instructions, complete "as built" wiring and block diagrams including input signals, and diagnostic and/or trouble-shooting guide shall be furnished to the Owner.
- Submit a complete list of all items to be furnished and installed under this section. Included manufacturer's specifications, catalog cuts, and other data to demonstrate compliance with the specified requirements.
- Submit complete shop drawings for all work in this section, showing dimensions and locations of all items including supporting structure and clearances required.
- Manufacturer's recommended installation procedures which, when approved by the Owner, shall be the basis for inspecting and accepting or rejecting actual installation procedures used on the work.
- Submit two (2) complete clean set of drawing prints and specifications with "as-built" conditions marked in crisp red ink. Sign and attest to the documents as reflecting all conditions "as-built".
- Provide two (2) copies of Operation and Maintenance Manuals, Installation Manuals and Parts Manual necessary for full servicing of the elevator and microprocessor.
- Provide one (1) Digital copies on "CD" "AS-BUILT" wiring drawings and O & M Manuals.

QUALITY ASSURANCE

- Elevator installer is responsible for quality assurance and insuring that all systems related to the elevator are complete and functioning properly.

MAINTENANCE

- Starting at the time of substantial completion of the complete project, provide complete systematic inspection and maintenance of the elevator for a period of 12 months. Furnish trained experts and equipment to check, adjust, lubricate, and otherwise maintain the elevator in operation without defects or deterioration. Replace or repair materials and parts, which become defective or deteriorated for any reason except through abuse or misuse by Owner.

USE OF ELEVATOR

- The elevator shall not be used temporarily for building construction purposes unless specifically allowed by the Owner.

- If the Contractor is allowed to use the elevator prior to Substantial Completion of the project, the warranty and service period shall not be compromised and shall begin when substantial completion is achieved.

ENGINEERED HYDRAULIC ELEVATOR

- **Acceptable elevator manufacturers are:**

- Kone Elevator Company
- Otis Elevator Company
- Schindler Elevator Company
- Thyssen Krupp
- Arizona Elevator Solutions

- **Attributes (Hydraulic Elevator):**

- Capacity: TBD
- Speed: TBD
- Operation: Selective Collective
- Control: Microprocessor based, Motion Control Engineering 2000 Hydraulic controller.
- Travel: TBD
- Stops: TBD
- Openings: TBD
- Platform size: TBD
- Clear inside car: TBD
- Car Doors: TBD
- Hoist way entrance: TBD
- Hoist way entrance finish: TBD
- Door Operation: G.A.L. MOVFR System
- Signals: Illuminated car and hall operating buttons, illuminated by light emitting diodes.
- Tamper Proof. SURVIVOR PLUS by Elevator Products Co. (EPCO) Alternate: Innovation Bruiser Series.
- Provide emergency access in all hoist way entrances.
- Photo curtain shall be model A850G7 Gatekeeper 2000 by Adams Elevator Equipment Co.
- Car telephone shall be model no. A936P3-2 as manufactured by Adams Elevator Co.
- Car Enclosure
 - Control panel (hinged to swivel for easy access) complete with the following:
 - Digital car position and direction indicators, illuminated with light emitting diodes.
 - Fan key switch (Keyed to an EPCO-1).
 - Emergency stop key switch (Keyed to an EPCO-1).
 - Independent service key switch (Keyed to an EPCO-1).
 - Inspection/access key switch (Keyed to an EPCO-2).
 - Fire-fighter service key switch (Keyed to AZFS).
 - COP Maintenance panel key to (Northeast J200).
 - Alarm bell push type switch.
 - Engraved capacity plate and elevator designation. Verify fabrication.
 - Engrave " INSPECTION CERTIFICATE ON FILE AT FACILITIES MANAGEMENT "
 - Light key switch (Keyed to an EPCO-1).
 - Emergency light located in car control panel.
 - Emergency light test button.
 - The car platform shall be provided with vinyl composition tile flooring. Color as selected by Owner.
 - All elevators that are subject to high material or equipment transport use or other extreme uses (i.e., heavy loading, wheeled carts, exterior opening) shall have aluminum diamond plate.

- For elevators that open to the exterior of a building the area surrounding the elevator entrance should be sufficiently sloped away from the entrance to prevent water from entering into the elevator hoist way.
- Suspended egg crate ceiling with baked enamel finish frame.
- Lighting: Cool white T8 fluorescent lighting.
- Handrails: Stainless Steel.
- Sill: Aluminum.
- Ventilation: Exhaust type, single speed squirrel cage, 300 CFM velocity exhaust blower. Isolate blower from steel cab canopy with rubber grommets.
- Provide hooks and removable blanket for protection of cab interior.
- Transom: Stainless Steel.
- For elevators with glass installed in the cab or hoist way each piece of glass shall be laminated glass conforming to ANSI Z97.1 or 16 CFR Part 1201 with respective markings on each piece of glass clearly and permanently visible after installation.
- Elevator shall have provisions for handicapped and complying with the requirements of ANSI A117.1 and ADAAG Guidelines.
- Furnish manufacturers standard 3 roller guide assemblies with spring tension and adjustable rollers. T-rails with all required mounting hardware required for mounting.

ENVIRONMENTAL CONSIDERATIONS

- Ambient temperature: 32 F to 104 F (0 C to 40 C).
- Humidity: not over 95% humidity.
- Vent machine room to outside to remove hydraulic fluid odors from building.

OPERATION, EQUIPMENT AND FUNCTION

- **Controller:** Solid State Motion Control Engineering 2000 controller for hydraulic elevators. Provide upgrade controller to be fully compatible with Owner's existing campus wide monitoring system. Mount controller to machine room wall to prevent vibration of solid-state equipment. Dedicated permanent status indicators shall be provided on the controller to indicate the following:
 - When the safety circuit is open, when the door locks are open
 - When the elevator is operating at high speed
 - When the elevator is on independent service
 - When the elevator is on fireman's service, when the elevator is out of service timer has elapsed
 - When the motor limit timer or valve timer has elapsed.

In addition, provide means of displaying other special or error conditions that are detected by the microprocessor. The elevator shall not require the functioning or presence of the microprocessor to operate on car top inspection or hoist way access operation (if provided) in order to provide a reliable means to move the car if the microprocessor fails.

- The elevator controller shall utilize a microprocessor based logic system and shall comply with (ANSI/ASME 17.1) safety code for elevators. The control equipment shall have all control parameters stored permanently on erasable programmable read-only memories (EPROM), and shall have permanent indicators to indicate important elevator status's as an internal part of the controller. The system shall provide comprehensive means to access the computer memory for elevator diagnostic purposes without need for any external devices. Systems that require hook-up of external devices for trouble-shooting are not acceptable.
- Failure of any single magnetically operated switch, contractor, or relay to release in the intended manner or the occurrence of a single accidental ground or short circuit, shall not permit the car to start or run if any hoist way

door or gate interlock is unlocked or if any hoist way door or car door or gate contact is not in the made position. Furthermore, while on car top inspection or hoist way access operation, failure of any single magnetically operated switch, contractor or relay to release in the intended manner or the occurrence of a single accidental ground shall not permit the car to move even with the hoist way door locks and car door contacts in the closed or made position.

- Dedicated permanent status indicators shall be provided on the controller to indicate the following:
 - When the safety circuit is open, when the door locks are open
 - When the elevator is operating at high speed, when the elevator is on independent service
 - When the elevator is on fireman's service
 - When the elevator is out of service timer has elapsed
 - When the motor limit timer or valve limit timer has elapsed.

In addition, provide means of displaying other special or error conditions that are detected by the microprocessor.

- A motor timer shall be provided which, in the event of the pump motor being energized longer than a predetermined time, shall cause the car to descend to the lowest landing, open the doors automatically and then re-close them. The car calls shall then be canceled and the car taken out of service automatically. Operation may be restored by cycling the power disconnect switch or putting the car on access or inspection operation.
- A valve limit timer shall be provided which shall automatically cut off the current to the valve solenoids if they have been energized longer than a predetermined time. The car shall then be canceled and the car taken out of service automatically. Operation may be restored by cycling the power disconnect switch or putting the car on access or inspection operation.
- An out of service timer (T.O.S.) shall be provided which will automatically take the car out of service if the car is delayed in leaving the landing while there are calls existing in the building. The car shall not respond to hall calls while in this mode of operation, and the photo eye input shall be unresponsive in the event that a faulty photo eye unit was delaying the car.
- Door protection timer shall be provided for both the open and close directions which will help protect the door motor and which will help prevent the car from being stuck at a landing. The door open protection timer shall cease attempting to open the door after a predetermined time in the event that the door is prevented from reaching the open position. The door close protection timer will reopen the doors for a short time in the event that the door-closing attempt fails to make up the door locks after a predetermined time.
- A minimum of three different door standing open times shall be provided. A car call time value shall predominate when a car call only is canceled. A hall call time value shall predominate whenever a hall call is canceled. In the event of a door reopen from a photo curtain, or door open button, a separate short door time value shall predominate. The timing value for these timers must be field adjustable.
- Nudging: If the doors are prevented from closing for longer than a predetermined time, door-nudging operation shall cause the doors to move at a slow speed in the close direction and to be unresponsive to the photo curtain. A buzzer shall sound while nudging operation is active.
- Hall or car call registration and lamp acknowledgment shall be by means of a single wire per call besides the power busses. Systems that register the call with one wire and light the call acknowledgment lamp with a separate wire are not acceptable.
- Fireman's Phase I emergency recall operation, alternate level Phase I emergency recall operation, and Phase II emergency in-car operation shall be provided according to applicable codes. Keyed (AZFS)

- Independent service operation shall be provided such that the actuation of a key switch in the car-operating panel will cancel any existing car calls, and hold the doors open at the landing. The car will then respond only to car calls and will ignore hall calls. Car and hoist way doors will only close by constant pressure on car call buttons or a door close button until the car starts to move. While on independent service, hall arrival lanterns or jamb mounted arrival lanterns and gongs shall be inoperative. Keyed (EPCO-1)
- Simplex selective collective automatic operation shall be provided for all single car installations. Operation of one or more car or hall call buttons shall cause the car to start and run automatically provided the hoist way door interlocks and car door contacts are closed. The car shall stop at the first car or hall call set for the direction of travel. Stops shall be made in the order in which the car or hall calls set for the direction of travel are reached, irrespective of the order in which they were registered. If only hall calls are set for the opposite direction of travel exist ahead of the car, the car shall proceed to the most distant hall call, reverse direction, and start collecting the calls. For multiple car installations use duplex, triplex etc.
- The car shall be equipped with two-way leveling to automatically bring the car within plus or minus (1/4") of landing level at any landing regardless of load.
- A selector switch shall be provided on the controller to select high or low speed during access or inspection operation as long as speed does not exceed 150 feet per minute.
- A test switch shall be provided. In the "test" position, this switch shall allow independent operation of the elevator without the door open function for purposes of adjustment or testing the elevator. The elevator shall not respond to hall calls shall not interfere with the other car in a duplex installation.
- A timer shall be provided to limit the amount of time a car is held at a floor due to a defective hall call or car call including stuck push buttons. Call demand at another floor shall cause the car to eventually ignore the defective call and continue to provide service in the building.
- Viscosity Control (optional and valve design must permit the use of this option) shall cause the car to accomplish the following operation. If a temperature sensor determines the oil is too cold, and if there are no calls registered, the car shall proceed to the bottom landing and, as long as the doors are closed, the pump motor will run without the valve coils energized in order to circulate and heat the oil to the desired temperature. In the event the temperature sensor fails, a timer shall prevent continuous running of the pump motor.
- **Solid State Motor Starter**
 - Provide a new solid-state motor starter to limit current inrush during starting and to provide gradual acceleration of the motor.
 - Motor starting shall not be initiated by mechanical contacts.
 - The starter shall include a current limit adjustment range of 200% to 450% of the overload adjustment range.
 - Provide an internal fault detection system, if the internal fault detection system detects a failure, power shall be removed from the motor.
- **Hydraulic Jack**
 - Install plunger-cylinder units plumb and accurate.
 - Plunger to be machined from extra heavy steel pipe (A53, Grade B) or equivalent mechanical tubing and ground to 24-32 or better micro-inch finish. The upper end of the plunger is equipped with a heavy steel plate inset and fillet welded into the plunger wall. This plate is drilled and tapped to receive standard machine bolts for attachment to the load platform. The bottom end of the plunger is provided with a steel striker plate welded to the plunger. Where the plunger is of multiple-piece construction, the coupling end is machine-bored, faced, and internally threaded to receive the coupling. All plunger joints are assembled and machined across the joint to assure matching surfaces.

- Install schedule 40 PVC auxiliary casing with bottom completely sealed. Size casing for minimum 1.5" clearance to all jack assembly components.
- Install piping without routing underground. Where not possible, rout piping through schedule 40 PVC before back filling.
- Hydraulic hose for sound deadening is not permitted.

- **Hydraulic Pump**
 - Pumping Unit: The pumping unit shall be of integral design and shall include an electric motor connected to a submersible pump, a hydraulic control system, hydraulic fluid reservoir and necessary piping connections all compactly designed as a self-contained unit. This unit shall be designed for vibration free operation. The unit shall be factory adjusted and tested before shipment to the job site. The testing procedure shall include actual job type conditions of load, speed, etc. Refer to the drawings for remote arrangement of hydraulic unit for this project.
 - The pump shall be specifically designed for all hydraulic operation and shall be of the positive displacement type. Oil flow shall be controlled in such a manner that car operation will be smooth and quiet in both directions of travel. Accurate car leveling shall take place in both the up and down direction. The control valve shall be easily adjusted from the front of the power unit.
 - The "up start" system shall be adjustable, designed to initiate the stop of the elevator, and shall control the acceleration smoothly and evenly.
 - The "down start" system shall be adjustable, designed to initiate the stop of the elevator, and shall control the deceleration of the elevator smoothly and evenly.
 - The power unit shall have a shut-off valve, which will isolate the oil reservoir to enable servicing of the pump hydraulic assembly. The shut off valve shall be located in the machine room as directed by Owner.
 - A suitable muffler designed to withstand the high pressure shall be installed in the power unit in a blowout proof housing.
 - Submersible Pump: The submersible pump shall be a positive displacement screw type to give smooth operation and shall be especially designed and manufactured for elevator service.

- **Elevator Pit Hydraulic Oil Return Pump**
 - Drip Pan Return Pump: 120V fractional h.p. pump suitable for pumping of hydraulic fluid. Furnish pump with float activated on/off switch.
 - Drip Pan: 24 gauge, galvanized sheet metal of suitable size to accommodate return pump.

- **Door Equipment**
 - Heavy Duty G.A.L. MOVFR Door Operating System, G.A.L. door rollers, door hanger tracks (car and hall) door pick-up assemblies, gate switch, door locks.
 - Provide emergency access in all hoist way doors.
 - All doors shall have 1-1/2 hr. label or other identification acceptable to governing authorities.
 - Provide adjustable nylon guide (by Nylube or Adams Elevator Equip. Co.).
 - Heavy-duty doors. Provide door skin on both sides of elevator doors.

- **Lobby Position Indicator**
 - Provide tamper resistant lobby position indicator on the ground level, illuminated by light emitting diodes. By Elevator Products Co. (EPCO).

- **Smoke Detectors**
 - Smoke and heat detectors shall be compatible and tie into building fire system.

- **Hall Direction Indicator**
 - Up and down tamper resistant SURVIVOR PLUS as manufactured by Elevator Products Co. (EPCO). Direction indicators to be provided in the hall wall with a single chime or tone for up and double chime or tone for down direction and shall be illuminated by light emitting diode.

- **Photo Curtain**
 - Photo Curtain: An electric, passenger-sensing device of the photo curtain shall project across the entrance to prevent the car and hoist way doors from closing if a passenger or object interrupts the curtain.
 - Nudging: If the doors are prevented from closing for longer than a predetermined time, door-nudging operation shall cause the doors to move at a slow speed in the closed direction and to be unresponsive to the photo curtain. A buzzer shall sound while nudging operation is occurring.

- **Car Operating Station**
 - Flush mounted operating panel shall be mounted in the car return panel and shall contain the devices required for the specified operation. The buttons and devices shall be of the easy readability type and the floor designation buttons shall become illuminated when pressed and shall stay illuminated until the floor call is answered. Provide continuous hinge on panel for easy access to internal components. Locate hinges on side of panel nearest wall of the elevator. The car operating shall contain the floor designations, and all the controls indicated.
 - Digital car position indicator, illuminated with light emitting diodes.
 - Fan key switch (Keyed to an EPCO-1).
 - Emergency stop key switch (Keyed to an EPCO-1).
 - Independent service key switch (Keyed to an EPCO-1).
 - Inspection/access key switch (Keyed to an EPCO-2).
 - Firefighter service key switch (Keyed to AZFS)
 - Alarm bell push type switch.
 - Light key switch (Keyed to an EPCO-1).
 - Engrave capacity and elevator designation.
 - Engrave " INSPECTION CERTIFICATE ON FILE AT FACILITIES MANAGEMENT "
 - Emergency light.
 - Emergency light test button.
 - Elevator Shutdown
 - Elevator power shall automatically shut down prior to sprinkler activation. This is typically accomplished by the use of a shunt trip breaker activated by a heat detector.
 - Heat detector to be located no more than 24" from any fire sprinkler head installed in elevator shaft or machine room
 - Heat detector should also report to fire alarm system
 - Conduit circuits to shut down elevator power shall be monitored and supervised by the Fire Alarm System.

EXECUTION

- **Telecommunication Link**
 - Install communication cable for controller modem not to exceed 24" from controller.
 - Install communication cable for car phone not to exceed 24" from controller.
 - Install modem MC – PA board and modem outlet inside of controller.

- **Adjust and Balance**

- Make necessary adjustments of equipment to ensure elevator operates smoothly and accurately.
- **Protection**
 - Locate and protect movable equipment and controls in such a way that they can only be operated by authorized persons.
- **Inspections**
 - Obtain and pay for inspections and permits and make sure tests are as required by regulations of authorities. Conduct all tests and inspections in the presence of the Owner.
 - Final inspection shall be after all new equipment is installed and operating correctly.
 - Inspect installation in accordance with ANSI-A17.2
 - Deliver test certificates and permits to Owner.
- **Operation and Maintenance**
 - Instruct Owner's personnel in proper use, operations and daily maintenance of elevators.
 - Training shall include operation of diagnostic microcomputer and servicing of elevator microprocessor.
 - Make final check of each elevator operation, with Owner's personnel present and just prior to date of substantial completion. Determine that control systems and operating devices are functioning properly.
 - Continuing Maintenance: Provide 1-year maintenance on elevators on an as-needed basis as part of standard 1-year warranty on new equipment and upgrades.
 - Maintenance shall include systematic examination, adjustment and lubrication of new elevator equipment; replacement of seals, packing and valves to maintain required factor of safety; performance of maintenance work without removing car during peak traffic periods and providing 24 hour emergency call back service during maintenance period, at an additional cost to Owner.
 - Repair or replace electrical and mechanical parts of the new elevator equipment using only genuine standard parts produced by manufacturer of equipment concerned.
 - Ensure that competent personnel handle maintenance service. Maintain an adequate stock of parts for replacement of emergency purposes, locally, and have qualified personnel available at such places to ensure the fulfillment of this service without unreasonable loss of time.
- **Cleaning**
 - Remove all trash and debris from site during elevator installation.
 - Clean all elevator surfaces, removing all dirt, dust, spots, and scratches. Any damage shall be repaired or replaced as directed by Owner, at no cost to Owner.
 - Prior to substantial completion, remove protection from finished or ornamental surfaces and clean and polish surfaces with due regard to type of material.
 - Remove tools, equipment and surplus materials from site.

End of Section 14 24 00

DIVISION 14 - CONVEYING EQUIPMENT

Section 14 28 16 – Elevator Controls

Introduction

There are unique College requirements.

Part 1 - General

- Consultants shall provide details on plans, clearly reflecting the requirements within. The consultant shall not specify pre-manufactured equipment for machine room shunt trip and control requirements. Specifically note on the plans that the pre-manufactured items are not acceptable.

- **POWER**
 - The consultant shall specify generous circuitry that accommodates circuit sizing requirements by vendors notorious for requiring over sizing. Provide notations that require the contractor to provide system upgrades when elevator equipment requires larger capacity system components in excess of that shown on the construction documents. The consultant shall explicitly state in the specifications that these upgrades shall be performed without additional cost to the College. The consultant is directed to intentionally size feeders for worse case conditions.
 - Provide a minimum elevator machine room size of 100 square feet, exclusive of the area above the hoistway (for traction elevators), and without any odd corners, narrow passages or structural interferences.
 - Main electrical elevator feed shall employ a molded case shunt trip breaker and a suitably sized enclosure. Larger enclosures for electronic type breakers are to be avoided as they take up too much room in an already cramped service space. Requirements for electrical coordination to be accomplished upstream of the main elevator feed. Engineers will feed the elevator breaker from the building's main switchboard, so as to maintain a 4 to 1 separation in current trip settings between the elevator breaker and the switchboard main breaker. This is to be done regardless of the convenience of any closer distribution points that cannot afford the 4 to 1 separation.
 - Ancillary electrical elevator equipment shall be fed from a separate, solely dedicated, elevator electrical DEADFRONT LOAD CENTER 120/208V, 3 phase, 4 wire. This elevator load center shall only be used for elevator related equipment and devices .It will provide the required means to lockout the equipment for service. Required characteristics of elevator electrical Load center are: surface mounted, copper bus, no door, dead front, 14 inches wide, lockable (lockout) breakers and a maximum size of 12 full size breaker spaces. Additional spaces are authorized only where the number of elevator related loads increases above 12 spaces. Unused breaker spaces shall not have any spare breakers installed. Ancillary elevator equipment to be fed from this panel may be, but is not limited to, the following:
 - Shunt trip control feed
 - Machine room lights/receptacles
 - Elevator car lights
 - Elevator pit lights/GFI receptacle
 - Elevator pit sump pump
 - Machine room A/C
 - Elevator Fan (A/C)
 - Hydraulic oil cooler

- Power for the machine room load center shall be on the life safety engine generator, when available.

Part 2 – Products

- **SHUNT TRIP AND RELATED CONTROLS**

- The machine shunt trip breaker shall be enclosed in a HOFFMAN ENCLOSURE having a dust tight-hinged door with external disconnecting handle for the breaker. The breaker shall be electronic type with LSI features, including short time adjustment. It shall have one N.O. and one N.C. contact for future use.
- The enclosure shall be oversized to accommodate the neat field wiring and installation of controls and relays associated with the requirements of all applicable codes.
- Terminal/barrier strips shall be 20 ampere rated, bakelite, industrial grade.
- Provide load center as described in Part 1, above.
- Provide 120 Volt control system with switch, Neon Pilot and Current Limiting (CL) fuse.
- Provide a schematic diagram and parts list for mounting within the enclosure.

Part 3 - Execution

No discussion.

End of Section 14 28 16

DIVISION 14 - CONVEYING EQUIPMENT

Section 14 40 00 – Lifts

Introduction

The application and use of stair lifts to provide a means of wheelchair access on new and existing stairs require careful consideration as these elements present significant operational, maintenance and safety concerns to the College. The College's experience has shown that only the following units provide reliable and trouble free service. Only the units identified below are to be considered acceptable for use on College projects.

Part 1 - General

No discussion.

Part 2 – Products

- Straight incline wheel chair lifts shall be Garaventa, model XPRESS II
- Vertical wheel chair lifts shall be Garaventa, model GVL-EN. Drive mechanism can be either hydraulic or screw type depending on the use and height of the lift.
- Curving or turning lifts, for going around corners or up a stairwell, shall be Garaventa models GSL-1 or GSL-3, depending on the specific needs of the unit.

Part 3 – Execution

- Factory assisted installation and set-up is required for all lifts.

End of Section 14 40 00

DIVISION 21 - FIRE SUPPRESSION

Section 21 13 00 – Fire-Suppression Sprinkler Systems

Introduction

This work shall be in strict accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction including, but not limited to the latest edition adopted by the College; NFPA codes, Arizona State Fire Code, PCC Facilities Planning.

Part 1 - General

- Hydraulic calculations and sprinkler system shop drawings shall be prepared and signed by a recognized design professional, to be submitted to the State Fire Marshal for approval.
- Designer and Contractor to conduct water supply static and residual tests, witnessed by PCC Environmental Health & Service, and provide fire flow information on shop drawings and hydraulic calculations.
- Provide a “Reduced Pressure” back-flow preventer located outside the building, with a 2½” flush port installed with a 2½” male hose connection controlled by a supervised valve and installed after the preventer but before the main alarm valve assembly.
- Potter Automatic Air Bleeders (PARR-B) shall be installed at the most hydraulically remote point in each zone of the system. Each automatic air bleeder shall be provided with an isolation valve to allow for maintenance. Each automatic air bleeder shall be monitored by the fire alarm system for water leakage.
- Provide a metal sign mounted on the main riser with the hydraulic calculations engraved.
- Provide an 8 ½" x 11" Map Key Plan for each floor of building, indicating the location of the following:
 - Main Control Valves
 - Fire Alarm Panel
 - Fire Dept. Connection (FDC)
 - Location of interior FDC's (wet or dry standpipes) if applicable
 - Back Flow Preventer
 - Fire Alarm Bell (24VDC)
 - Auxiliary Drain Valves
 - Inspectors Test Connections
 - Gallons per Floor/Zone
- Provide fire document box (#SSU00672 from www.1sae.com) at main control valve, complete with key plan.
- All valves shall be readily accessible for maintenance between 12 inches and 60 inches above finished floor.
- Provide a spare head box mounted next to the main control valve. Ensure there are sufficient quantity and type as required by NFPA 13 Standard for Installation of Sprinkler Systems. Ensure there is a head wrench and / or socket with ratchet as needed to replace any installed head in the system.
- Provide system signage and identification in accordance with NFPA 13 standard for installation of sprinkler systems. Include placing signs on doors to all fire suppression equipment pumps, valves, test points, and drains.

- Provide a bound and “bookmarked” pdf copy of system “as-built” drawings for use of Facilities – PCC Environmental Health & Safety.
- To facilitate the annual fire pump test, all fire pump installations shall include a fire pump test header (controlled by a supervised valve, with the discharge located outside in a location approved by PCC Environmental Health & Safety). The test header shall be located as to allow the test to be performed without excessive flooding of the streets or damaging landscape.
- In buildings equipped with, or to be equipped with fire pumps, provide monitoring to identify failure of jockey pump prior to the start of fire pump due to loss of pressure.
- In buildings equipped with, or to be equipped with, pre-action sprinkler systems they shall be double inter-locked and shall use a nitrogen supply (Potter NGP Series) to reduce corrosion in the piping system and shall be installed with a nitrogen bleeder at the remote point of the pre-action system.

Part 2 - Products

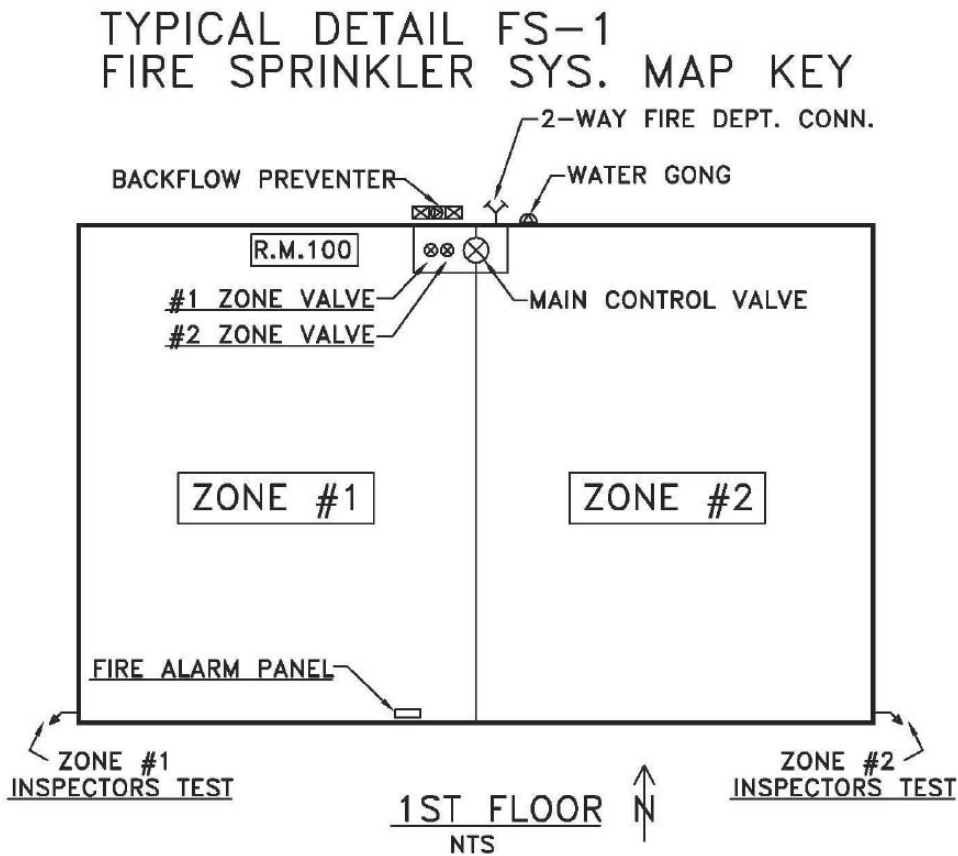
- Piping below grade shall be Cast Iron or AWWA C900.
- Piping above ground shall be schedule 40 ASTM A-53 Grade A or B. or If “Pipe Shield” chemical treatment system is installed schedule 10 piping, Bull Moose, Dyna Flow, or equal may be used in the chemically treated part of the system.
- All grooved fittings shall be UL and Facilities approved. Victaulic 009H fittings are not to be used.
- Potter shall manufacture all automatic air bleeders, chemical treatments, chemical injector systems, and nitrogen systems.
- All control valves shall be gear operated butterfly type, minimum valve handle size is 5” diameter.
- All non-control valves shall be ball type.
- All control valves shall have integrated tamper-monitoring switches monitored by the fire alarm system.
- Provide electronic pressure monitoring of the supply and system sides of the fire sprinkler system using 24VDC ¼”NPT 4-20ma transducers that provide a range of 0-300psi with a burst rating of at least 400psi. They shall be installed in the same location as the system and supply pressure gauges.
- All check valves shall be UL listed and Factory Mutual approved and shall be equipped with a removable cover assembly. Check valves shall be listed for installation in the vertical or horizontal position. Riser check valves shall be equipped with gauge connections on the system side and supply side of the valve clapper and a main drain outlet in the body of the valve above the rubber faced clapper assembly. Riser check valve trim piping to be externally galvanized. All check valves shall withstand a maximum water working pressure to 250 PSI.
- All FDC’s shall be National Standard Hose thread.

Part 3 - Execution

- Piping shall be installed in areas protected from freezing. Designer shall route piping to avoid sprinkler lines being subjected to freezing. If piping must be located in areas subject to freezing, obtain written approval from PCC Environmental Health & Safety and Risk Management.

- PCC Risk Management and Environmental Health & Safety to be notified 48 hours in advance of all system tests, e.g. underground flushing, hydrostatic test, flow alarm test, fire pump test (if applicable), fire alarm/final acceptance test.
- No saddle type fittings shall be used on fire protection systems.
- System main drain and auxiliary drain(s) sizes shall be in conformance with N.F.P.A. 13. Auxiliary drain valves shall be installed when trapped water will be collected in accordance with NFPA 13. A plugged or capped outlet will not substitute for a required drain valve. A sprinkler head will not eliminate a required auxiliary drain valve. Drains shall be routed through an exterior wall and shall be piped in galvanized piping where it extends through the wall. The exterior drain shall terminate at a turned down galvanized 45° ell to discharge at a splash block to prevent damage to the landscape. A gang drain may be used.
- Inspector's Test Connections and main drain shall be piped to a suitable location outside of building. Do not pipe to a floor drain, janitor's mop sink or similar. A gang drain system may be used.
- System piping shall not be buried beneath building slabs on grade.
- If a standpipe is required, a combination wet standpipe / fire riser is preferred. All standalone standpipes shall be wet type with the exception of parking garages which shall be dry type (Dry piping shall be above ground). Locate the fire department connection (FDC) adjacent to the sprinkler system FDC.
- In all new construction and in major renovation projects the entire system shall have a final "all heads installed" 2 hour 200-psig pressure test through the FDC. Isolate the RP Backflow device during the test.
- Check valves, sprinkler valves and flow switches and main drain valve shall be readily accessible.
- At check valves, support piping independent of valve to allow for service removal without additional pipe support.
- FDC shall be horizontal type; wall mounted to the building structure on the street side by the main entrance, at a point as close as possible to the nearest fire hydrant, and shall be mounted in an area un-obstructed by building features to include landscaping. (Minimum 5ft clear on both sides). As an alternate, the FDC can be integrated with the reduced pressure backflow preventer located in a location approved by PCC Risk Management and Environmental Health & Safety. Inspector's test valve shall be installed at the most hydraulically remote point in each zone of the system.
- Local bell shall be powered and supervised by the fire alarm panel.
- For all installations, do not use saddle tees. Use grooved fittings or welded outlets only.
- Welders qualified in accordance with the minimum requirements of ASME Section IX Welding and Brazing Qualifications shall do all welding of fire suppression piping. Ensure all piping:
 - Is clear of discs
 - Has smooth openings
 - Welds are free from cracks
 - Is clear of weld splatter
- Do not enclose grooved fittings within construction.
- All pendant sprinkler heads in suspended ceilings to be installed at quarter points or center of ceiling tile.

- Shop drawings shall incorporate all of the design features shown on the contract drawings. Any deviations deemed necessary by the designer shall be clearly identified on the shop drawings, i.e.: clouded.
- Contractor shall submit shop drawings to the Architect/Engineer and PCC Project Manager for review and approval, prior to submittal to the State of Arizona Fire Marshal.
- All new construction and major renovation projects shall be fully sprinklered and equipped with class-A fire alarm systems – Edwards EST-EST 3 Fire Alarm System.



PIMA COMMUNITY COLLEGE	
MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL: FIRE SPRINKLER SYSTEM MAP KEY	
DETAIL NO.:	21 13 00-D1

End of Section 21 13 00

DIVISION 22 - PLUMBING

Section 22 00 00 - General Requirements

Introduction

The work shall be in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction.

Refer any questions, clarifications regarding Division 22 to PCC Planning & Construction.

Part 1 - General

- Codes
 - The project shall comply with the following codes and PCC rules and regulations of authorities having jurisdiction:
 - Arizona State Fire Code/National Fire Protection Association with Amendments
 - Current International Building Code with Amendments
 - National Electrical Code
 - International Mechanical Code
 - International Plumbing Code
 - N.F.P.A. (as referenced in the adopted codes)
 - Occupation Safety and Health Act
- Testing
 - To comply with current International Building Code testing requirements.
- Working In Confined Spaces
 - Whenever work is required within a confined space, e.g., utility vaults, utility tunnels, sumps, pits, sewers, etc., contact PCC Environmental, Health and Safety Department for details and procedures on PCC Confined Space Entry Program.
- Laboratory Design Criteria
 - Refer to PCC Facilities Guidelines and Specification Standards , Tab B-1 – Laboratory Planning and Design.
 - Discuss fume hood selection and HVAC system criteria with PCC Facilities Planning.
- Record Drawings
 - Provide a set of prints and clearly mark, as the job progresses, all changes and deviations from that shown on Contract Drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include; change orders, field instructions and all other changes.
 - Reference Division 01 for further details.
- Buried Services
 - After inspection and approval of service lines in trenches, provide a continuous trace wire and attach to service line directly. The Mechanical Contractor shall take ‘as-built’ measurements, including all depths, prior to commencement of backfilling operations. It will not be sufficient to check off line locations.

Definite measurements shall be taken for each service line. The location of buried piping shall be shown on the drawings and dimensioned from fixed points.

- Provision For Future Expansion and/or Installations
 - Where piping and equipment is indicated for use in future expansion of the building and/or for future installations within the building, the Contractor shall leave sufficient clear space and install the piping and equipment in such manner that connections to the future building expansion and/or future installations within the building can be made without removing existing floors, walls, ceilings. The Contractor shall consult with the Architect/PCC whenever necessary for this purpose.
 - Any piping stub-outs provided for future connections to domestic hot and cold water piping systems shall be arranged so that “dead legs” (i.e., pipe sections where there is no water circulation) are prevented. The termination point of any piping stub-out shall be as close to the main piping flow as physically possible. Where future branch lines must extend a distance greater than six (6) branch line pipe diameters or more than 18” from the main piping flow, a valved drain port or blind flange with a valved drain shall be provided at the end of the branch piping to allow periodic flushing.

- Abandonment of Domestic Water Piping
 - Verify routing of existing domestic hot and cold water piping systems prior to their being abandoned. Cap abandoned branch lines as close as physically possible to the main piping flow to eliminate “dead legs”. Elimination of “dead legs” shall not hinder the proper operation of any existing hot water return, i.e., recirculation, systems.

End of Section 22 00 00

DIVISION 22 – PLUMBING

Section 22 05 00 – Common Work Results for Plumbing

Part 1 - General

- All electrical work associated with Division 22 shall comply with requirements of Division 26 - Electrical.
- Refer to section 23 05 93 – Testing, Adjusting and Balancing for HVAC for testing requirements.

Part 2 - Products

Valves

- Sizes 6" and above shall have gear operator ball chain if located more than 7 ft. above floor.
- Provide isolation Ball valves - 100% full port, full-line size, bronze-body, threaded or soldered connections at all equipment and on all main branch take-offs.
- Provide brass valve tags marked for the service. See pertinent service specification for valve type.
- Butterfly valves shall be 100% bubble-tight shut-off. Lug type only. Iron body with bronze disk. Valves to have two-year warranty. Use for throttling/balancing. Preferred manufacturers are domestic or PCC approved equal.

Piping Labels

- Provide at directional changes and/or each 20 ft. Labels to be pre-manufactured snap-on plastic wrap-around type (where not exposed to UV) sized to cover entire circumference of piping and insulation.
- Where labeling exposed to UV, provide labels and fasteners that are metal or other material not susceptible to UV damage. The College shall approve proposed product.
- Labels to have integral color identification as established by ANSI Standard A13.1 - 1981.
- Lettering shall be sized to be easily legible. Directional arrows shall indicate direction of flow and shall be located to point away from lettering.
- Markings to all piping shall be visible prior to insulation and identifiable for inspection.

Escutcheons

- Install in exposed locations, except in mechanical rooms.
- Escutcheons to be chrome-plated type.

Pipe Sleeves/Concrete Walls and Floors above Grade

- Shall be schedule 40 steel.
- Sized for full dimensions of insulation and fire caulked where required.
- Install in all exterior walls, firewalls and floors.
- Sleeves are not required in cored concrete except wet area floors
- Floor sleeves to extend 1" above floor surface in wet areas.
- Pipe sleeves in non-rated, non-masonry walls or partitions. Provide 24-gauge galvanized steel.
- Pipe sleeves in rated non-masonry wall or partitions. Provide listed approved fire-rated assemblies.
- Pipe sleeves installed below ground through exterior walls shall have mechanical type neoprene seals.

Pipe Hangers

- Use Vibra-Zorb cushioned supports on 1 ¼" pipe and smaller which is connected to vibrating equipment.

- Provide piping support hangers to ensure that no sags occur. Minimum hanger rod sizing and maximum hanger spacing shall conform to following table:

Material	Pipe Size	Spacing	Hanger Rod
Steel Pipe	½"	6'-0"	3/8"
	¾" through 1-¼"	8'-0"	3/8"
	1-½, 2"	10'-0"	3/8"
	2-½"	10'-0"	3/8"
	3"	12'-0"	3/8"
	4"	12'-0"	3/8"
	5"	12'-0"	1/2"
	6"	12'-0"	1/2"
	8-12"	12'-0"	5/8"
Copper Pipe	½"	6'-0"	3/8"
	¾", 1"	8'-0"	3/8"
	1-¼ through 4"	10'-0"	3/8"
	5"- 6"	12'-0"	1/2"
	8" and above	12'-0"	5/8"
Cast Iron	1 ½ "- 2"	1 ea. Joint	3/8"
	3"	1 ea. Joint	1/2"
	4" through 6"	1 ea. Joint	1/2"
	8" and above	1 ea. Joint	5/8"
Vertical risers shall be supported at each floor line with steel riser clamps			

Equipment Nameplates

- Provide nameplates for all pieces of equipment.
- Nameplate shall be minimum of 3/32" thick laminated phenolic plastic.

Access Doors

- Minimum size 12"x12" for wall access - provide 24" x 24" for ceiling access.

Motors

- Motors shall have premium efficiency EPAC rating in accordance with IEEE Standard 112 test method B.
- Motors shall have a minimum service factor of 1.15 and the design load shall not exceed 1.0.
- Motors located in conditioned space shall have an ambient rating of 104° F (40°C). Motors in unconditioned space shall have an ambient rating of 122° F (50°C).

• Part 3 - Execution

Workmanship

- Piping to run parallel to building lines.
- Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- Particular attention must be paid to the proximity of mechanical piping and equipment to electrical conduit and cable.
- All underground utility pipe shall have a tracing wire that is electrically continuous. The wire shall be 14TW AWG stranded (green – sanitary waste lines, purple – reclaimed water, blue – water, yellow - gas) wrapped around or buried alongside the pipe, taped every 8' The wire shall be terminated at either end in a box flush with the ground with 3 feet of coiled wire in the box.

- Pitch piping in direction of flow 1" per 40 ft.
- Piping to be inspected and pressure tested prior to insulation.
- Piping to be routed to allow access to equipment.
- Welding to be done by welders certified locally in the State of Arizona. Welders must have proof of certification in their possession.
- Weld inspection
 - Visual inspection on low pressure piping (CHW, Condensate, LPS, HW, etc.).
 - Visual inspection and optional radiography on medium and high pressure steam piping (MPS, HPS).
- Do not support pipe with sleeve.
- Pipes on trapeze type hangers shall be firmly secured.

Installation

- Install strainers with full port ball valve on blowdown. Provide hose threaded connection on valves 3/4" and below.
- All gauges to be installed with a single gauge manifolded with ball valves on both sides of pumps, heat exchangers, tunnel supply and return, etc.
- Install valves with stems in vertical position except ball valves. Do not go below horizontal with ball valve stems.
- Use 10-mil plastic wrap around copper pipe on ferrous hangers or supports.
- Use dielectric fittings whenever joining dissimilar metals.
-

Equipment Installation/Removal

- Provide access to all equipment in accordance with the Mechanical code and Manufacturer's recommendations, for maintenance, servicing and removal.
- Provide a means of removing any valve that is larger than 2" and is mounted six feet or more above floor level.

Domestic Water Piping Arrangement

- Provide recirculating loops for all domestic hot water piping systems with pipe runs longer than 50 feet.
- Arrange piping in such a manner that there are no "transitory dead legs", i.e., piping branch lines that contain stagnant water. All abandoned branches or futures to be as close to main as possible, but in no case longer than 6" pipe diameters or 18" for pipe over 3".
- Refer to "Provisions for Future Expansion and/or Installations" Section 22 00 00 - General Discussion for the installation requirements of future connections.

Electrical conduits shall not touch or be supported via pipes or ducts.

Ensure fire and smoke separation rating of walls and floors is maintained via appropriate protection of openings and penetrations.

End of Section 22 05 00

DIVISION 22 - PLUMBING

Section 22 10 00 - Plumbing Piping

Introduction

Piping and specialties associated with plumbing systems including:

Domestic water systems, sanitary sewer and waste piping systems, laboratory waste systems & natural gas.

Part 1 - General

- Refer to 22 05 00 – Common Work Results for Plumbing for common piping materials and methods.
- Single stack waste vent systems (sovent) shall not be designed into any facility.
- Refer to meter requirements (attachment to Section 25 55 00 - Integrated Automation Control of HVAC).
- Refer to section 23 05 93 – Testing, Adjusting and Balancing for HVAC for testing requirements.

Part 2 - Products

- **Pipe Schedule**

Service	Size	Pipe Material	Fittings	Joints
Domestic Water (above grade)	Up to 2"	Copper Type "L" seamless Hard Drawn	Wrought Copper or Cast Brass	Non Lead Bearing Solder
	2 ½" and Larger Subject to change due to confined spaces	Copper Type "L" seamless Hard Drawn	Wrought Copper	15% Silver Brazed
Domestic Water (below grade)	All	Copper Type "K" seamless Hard Drawn	Wrought Copper	15% Silver Brazed
Low Pressure Natural Gas (above grade)	Up to 2"	Scheduled 40 Black Steel	Steel	Threaded
	2 ½" and Larger	Schedule 40 Black Steel	Black Steel	Beveled Weld
Low Pressure Natural Gas (below grade)	All	Same as above grade with sealed coating		
Drainage/Vent Piping (except lab waste)	All	New Age Epoxy Coated No Hub Cast Iron Pipe	Cast Iron Epoxy Coated	Hubless with Husky SD 2000 Assemblies or PCC Approved Equal
Sanitary Sewer/Waste (below grade)	All	Cast Iron Epoxy Coated	Cast Iron Epoxy Coated	Hubless with Husky SD 2000 Assemblies
		PVC Schedule 40	PVC Sch 40 DWV	Solvent Weld
Sanitary Sewer/Waste (above grade)	All	Cast Iron Epoxy Coated No Hub Pipe	Cast Iron Epoxy Coated No Hub	Hubless with Husky SD 4000 Assemblies

Laboratory Waste/Vent	All	Polypropylene	Polypropylene DWV	Fusion Welded
		CPVC Schedule 40	CPVC DWV	Solvent Welded
High Temperature Waste (autoclave cage wash, etc.)	All	Duriron Alt Mat	Duriron DWV	Mechanical Joint

- Back Flow Prevention: Backflow prevention standards will be equal to or greater than USC's Foundation For Cross-Connection Control and Hydraulic Research Manual #9, or the newest edition printed. Y Type configuration.
- Hose Bibbs: Keyless in public areas. Woodford Brand.
- Wall Hydrant: Automatic-draining, anti-backflow type. Provide one operating key.
- Floor Drains: Pima County Waste Water ordinance prohibits floor drains in chemical using areas. Cast iron body. Floor drains for use as area drains in exterior slab on grade shall be furnished with anchor flange. Airgap fittings shall be cast iron or cast bronze, with fixed air gap, inlet for drain pipe or tube, and threaded or spigot outlet. Provide seepage flange at all floor drains in suspended slabs. Provide inline trap protection at all floor drains. (Proset trap guard or equal)
- Floor sinks: Acid resistant enamel coated cast iron. Strainer/grating shall be chosen appropriate for service.
- Roof Drains and Overflow Drains: Cast iron roof drain with cast metal dome strainer.
- Roof Flashing Assemblies: Construct of four pound per square foot lead (min. of 24" x 24" cut for drain and clamped at collar).

Part 3 - Execution

- Excavation for buried piping shall be graded to provide a smooth foundation throughout length of piping. Bedding with clean sand to indicated level. Dig bell holes at each pipe joint to relieve protrusions of loads and to ensure continuous bearing of pipe barrel on foundation.
- Install sanitary building drain piping at a minimum slope of 1/4" per foot (2 percent).
- For natural gas piping, provide dirt leg at each point of connection to equipment.
- Install cleanouts in drain piping as required by the plumbing code and at each sewer main change in direction of 90°, at minimum intervals of 50 feet for piping 4 inches and smaller and 100-foot minimum intervals for larger piping. Install cleanouts at the base of each vertical soil or waste stack. Exterior cleanouts shall be two-way.
- Extend wall cleanouts out to finished wall.
- Reduced pressure backflow preventers shall be installed at service into building, and at connections between potable and non-potable water systems.
- Anti-siphon, pressure type vacuum breakers shall be installed at connection to irrigation systems.
- Install laboratory waste piping in an accessible pipe way.
- Island Venting may be used for laboratory waste.

- Install strainer on building potable water supply after building shut-off and prior to backflow preventer.
- Install ball valves with hose end threads for system drains.
- Water hammer arrestors to be sized according to number of fixture units and installed on all branches with quick closing devices (e.g. flush valves, solenoid valves, etc.). Quantity and location of arrestors shall be shown on the design drawings and follow Standard PDI WH 201.
- Provide floor drains for all wet areas. Floor sinks shall be used for indirect waste only. Floor sinks shall be installed with rim above finished floor.
- Ball valves to be threaded ends with downstream union.
- Top of floor drain grate shall be the lowest point on the floor and shall readily drain the entire floor.

End of Section 22 10 00

DIVISION 22 - PLUMBING

Section 22 30 00 - Plumbing Equipment

Introduction

Equipment associated with building plumbing systems including:

Water softener, sewage ejector pumps, hot water generators, water heaters, & water pressure booster systems.

Part 1 - General

- For energy conservation purposes, hot water shall not be provided to restrooms.
- Use central plant steam via heat exchangers for hot water. Consider impact of summer shutdown of steam service, (backup systems may be required) - consult with PCC Planning Design & Construction.
- Where used, water heaters shall be placed as near point-of-usage location as possible. Pumped recirculation system is required for piping systems lengths exceeding 50 feet.
- Small clear water ejector systems (fractional horsepower only) may use drop-in submersible pump.
- Autoclaves shall be connected to campus steam system and not furnished with individual steam generators. Verify adequate steam supply main pipe size and available pressure. Provide timers with over-ride button to shut off steam and water when not being used.

Part 2 - Products

- Water Softeners shall be dual automatic regenerating type to provide service during routine maintenance, complete with fiberglass tanks.
- Sewage Ejector Pumps shall be self-priming, base mounted pump with suction line extended to sewage pit, high water alarm PCC Campus EMCS. Provide two sewage ejector pumps for stand-by service with lead/lag control for building service application. Provide vent bleed valve per manufacturer's recommendation. Preferred manufacturer is Gorman Rupp or PCC approved equal.
- Water Heaters, gas fired preferred, although electric spot heaters may be used where economically justified. Lined galvanized steel tanks. 80 percent minimum efficiency.
- Water Pressure Booster System shall be Duplex pumping system, with removable bladder type hydropneumatic pressure tank. Booster pumps to have VFD's and be connected to the building EMCS (Section 25 55 00 – Integrated Automation Control of HVAC). Use of proprietary control systems from system manufacturers is not acceptable. VFD's must comply with Section 40 97 00 – Variable Frequency Drives.
- Multi-plex pumps shall each have an H-O-A switch, disconnect, and overcurrent protection.

Part 3 - Execution

- All equipment shall be installed with isolation valves (threaded ball or flanged butterfly) - 100% full-port, full line size, bronze body at the equipment, drains, thermometers (on heat exchange equipment) and pressure gauges.
- Provide drip pans with piped drain beneath water heaters placed in areas other than in equipment rooms.

- Provide line size (2" maximum) full port ball valve blowdown on each side of heat exchangers (typically 4).

End of Section 22 30 00

DIVISION 22 - PLUMBING

Section 22 40 00 - Plumbing Fixtures

Introduction

Fixtures and appurtenances associated with the use of plumbing system-piping including:

Domestic water systems & sanitary sewer systems.

Part 1 - General

- Refer to Section 22 00 00 – General Discussion “Provisions for Future Expansion and/or Installations and Section 22 05 00 – Common Work Results for Plumbing Part 3 – “Execution”.
- All fixtures shall be of the “water saving type”.
- Install fixtures as required for either standard or handicapped accessible service per ADA.

Part 2 - Products

- Water Closets, Wall Mount shall be domestic and provided with:
 - Vitreous china construction, white
 - Elongated bowl
 - 1 ½" inlet spud
 - Siphon jet action
 - ANSI Standard A112.19.2
- Toilet Seats shall be domestic:
 - Open front.
 - Injection molded of high strength, impact, and chemically resistant polypropylene.
- Flushometers
 - Manufactured by Sloan (Royal # 111 for water closets 1.6 gpf, Royal #186 for urinals, 1.0 gpf)
- Faucets And Trim shall be/provided with:
 - Cast brass with polished chrome plating.
 - All faucets and trim furnished shall be by Chicago Faucet, American Standard, T&S, Delta dependent on application use.
 - No push button faucets.
 - Single lavatory faucet for rest rooms (no hot water).
 - Moderators
 - Plug and tailpiece: P.O. plug with 13" tailpiece. Non-removable strainer with integral spud. (No. 327)
 - DI water faucets shall be PVDF lined, self-closing, with swing gooseneck.
- Wall Mount Lavatories shall be/provided with:
 - Vitreous china with:

- Front overflow
 - Self-draining deck area with contoured back and side splash shields
 - 4" centers or as required for handicapped faucets
 - Equipped for carrier
 - ANSI Standard A112.19.2
- Urinals shall operate as waterless as follows:
 - Urinals to be vitreous china, white, Zurn Model number Z5750
 - Provide programmable Flushometer with Ecoblue flush control (EAUTO)
 - Tailpiece to be PVC-DWV pipe (no copper to be used to eliminate corrosion issues)
 - Two wall hangers
 - ASME Standard A112.19.2 M-95, ANSI Z 124.9-94
- Mop Sinks (Floor Service Sink) shall be/provided with:
 - Acid resisting, enameled cast iron
 - Removable vinyl-coated rim guard
 - 3" drain
 - ANSI Standard A112.19.1.M
- Service Sinks shall be/provided with:
 - Acid resisting, enameled cast iron
 - Rim guard
 - Wall Hanger
 - Drilled for back mount faucet
 - Floor supported trap
 - ANSI Standard A112.19.1.M
- Stainless Steel Sinks shall be/provided with:
 - 18-gauge brushed stainless steel.
 - Flat back extension with centerset holes 8" on center for faucet set.
- Water Coolers shall be/provided with:
 - Bottle filling station preferred manufacturer Elkay.
 - Single unit, installed at height for handicapped accessibility/operation.
 - One-piece stainless steel backsplash plate and basin.
 - Exterior casing to be stainless steel or vinyl coated steel.
 - 8.0 gallons per hour minimum capacity.
 - Non-CFC refrigerant.
 - Fittings, Except Faucets
 - Angle stops and other fittings shall be fabricated of brass with a polished chrome plated finish.
 - Trap piping and tailpiece shall be chrome plated finish.
 - Escutcheons: polished chrome-plated, steel shell wall flange with friction clips.
- Plumbing Fixture Supports shall be/provided with:
 - ASME rated for service.

- Chair carriers: supports with steel pipe uprights for wall hanging fixtures. Heavy-duty chair carrier shall have rectangular steel uprights.

Part 3 – Execution

- Refer to Section 22 00 00 – General Discussion “Provisions for Future Expansion and/or Installations and Section 22 05 00 – Common Work Results for Plumbing Part 3 – “Execution”.
- Installation
 - Install stop valves in a readily accessible location.
 - Install escutcheons at each wall and ceiling penetration in exposed locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
 - Seal fixtures to walls, floors, and counters using a sanitary type, one part, and mildew resistant white silicone sealant.
 - Single faucets shall not be used in conjunction with cock hole covers. Provide lavatory or sink with correct hole configuration for specified service.

End of Section 22 40 00

DIVISION 22 - PLUMBING

Section 22 60 00 - Gas and Vacuum Systems for Laboratory and Healthcare Facilities

Introduction

Special plumbing systems including:

Laboratory water systems, medical gas systems, compressed air systems & vacuum systems.

Part 1 - General

- Refer to section 23 05 93 – Testing, Adjusting and Balancing for HVAC For testing requirements

Part 2 - Products

- **Pipe Schedule**

Service	Size	Pipe	Fittings	Joints
Laboratory RO water	All	Schedule 80 PVC	Schedule 80 PVC	Solvent Welded
High Purity Water	All	Polypropylene Type 1 Schedule 80	Polypropylene Type 1 Schedule 80	Fusion Weld Mechanical Joint
Medical Gas	All	Copper Type "L" Oxygen Grade	Wrought Copper	15%silver Solder
Compressed Air	All	Copper Type "L"	Wrought Copper	Less Than 0.2% Lead Alloy Solder
Lab Vacuum	All	Copper Type "L"	Wrought Copper or Cast Brass	Less Than 0.2% Lead Alloy Solder
Specialty Gases	All	Review with User for requirements and discuss with PD&C		

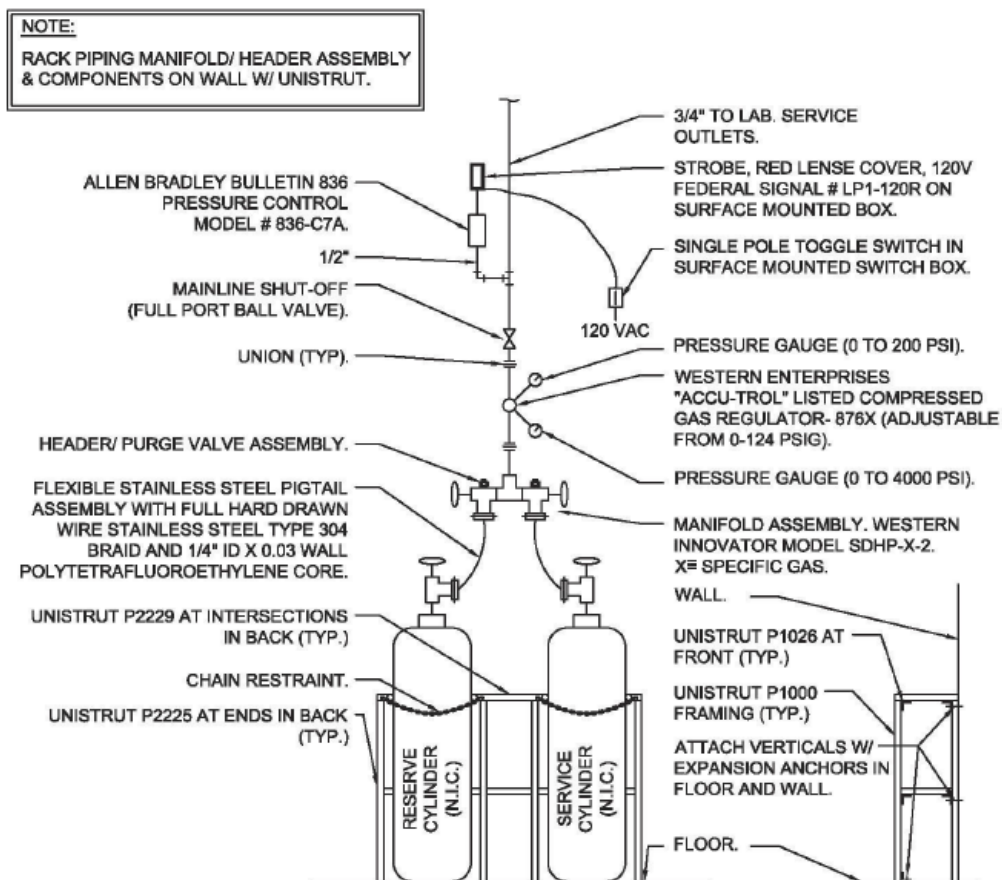
- Laboratory High Purity Water Systems
 - Utilize campus-wide RO water system where available with local filtration purifiers where required by user.
 - Where building wide high purity water is required, utilize a complete system by a single manufacturer to ensure a single point of responsibility.
 - Piping system shall be Schedule 80 PVC solvent welded for campus-wide RO system.
 - No tapered connectors shall be utilized on faucets.
 - Sterilize system before handover to PCC.
- Compressed Air Systems shall be/provided with:
 - Oil-less compression for medical application.
 - Automatic drain valve c/w isolation valve.
 - Air dryer with air dryer bypass valve (if required).
 - Conditioned inlet air preferred.
 - Filter inlet.
 - Oil and moisture separators.

Part 3 - Execution

- Workmanship

- System Cleaning - fill laboratory water systems and hold water for 24 hours prior to flush. Flush clean 3 times.
- All vacuum pumps must be vented to the exterior of the building. A screened vent opening with 2 90 degree forming a candy cane or J effect.
- Vacuum pump tanks must be drained to waste container.
- Provide bypass around filter assembly for servicing.
- Purge medical gas systems with nitrogen during soldering.

SPECIAL GASES MANIFOLD DIAGRAM



NOTE:
 PRESSURE SWITCH/ CONTROL SHALL ENERGIZE STROBE WHEN MAIN LINE PRESSURE IS 15 PSIG LESS THAN SYSTEM DISCHARGE (SETTING) AT PRESSURE REGULATOR.

NOTE:
 WALL MOUNTED CYLINDER BRACKET SIMILAR TO GRAINGER SERIES 4ZH MAY BE USED INSTEAD OF UNISTRUT SUPPORT WITH USER'S PERMISSION.

SERVICE SCHEDULE		
SERVICE	PIPE SIZE	PRESSURE
ARGON	3/4"	80 PSI
HELIUM	3/4"	80 PSI
NITROGEN	3/4"	80 PSI

PIMA COMMUNITY COLLEGE MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL:	SPECIAL GASES MANIFOLD DIAGRAM
DETAIL NO:	22 60 00-D1

End of Section 22 60 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 00 00 - General Requirements

Introduction

The work shall be in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction.

Refer any questions, clarifications regarding Division 23 to PCC Planning & Construction.

Part 1 - General

- Codes
 - The project shall comply with the following codes and PCC rules and regulations of authorities having jurisdiction:
 - Arizona State Fire Code/National Fire Protection Association with Amendments
 - 2018 International Building Code with Amendments
 - National Electrical Code
 - International Mechanical Code
 - International Plumbing Code
 - N.F.P.A. (as referenced in the adopted codes)
 - Occupation Safety and Health Act
- Working In Confined Spaces
 - Whenever work is required within a confined space, e.g., utility vaults, utility tunnels, sumps, pits, sewers, etc., contact PCC Risk Management Services and Environmental, Health and Safety Department for details and procedures on PCC Confined Space Entry Program.
- Laboratory Design Criteria
 - Refer to PCC Facilities Guidelines and Specification Standards , Tab B-1 – Laboratory Planning and Design.
 - Discuss fume hood selection and HVAC system criteria with PCC Facilities Planning.
- Record Drawings
 - Provide a set of prints and clearly mark, as the job progresses, all changes and deviations from that shown on Contract Drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include; change orders, field instructions and all other changes.
 - Reference Division 01 for further details.
- Buried Services
 - After inspection and approval of service lines in trenches, provide a continuous trace wire and attach to service line directly. The Mechanical Contractor shall take ‘as-built’ measurements, including all depths, prior to commencement of backfilling operations. It will not be sufficient to check off line locations. Definite measurements shall be taken for each service line. The location of buried piping shall be shown on the drawings and dimensioned from fixed points.
- Temporary Use Of Equipment

- Permission must be obtained from Architect/PCC Project Manager prior to operating any mechanical systems during construction.
 - Where the mechanical systems are operated during construction, the Mechanical Contractor shall maintain the system and equipment in proper operating condition. Note that the warranty period starts at substantial completion.
 - Before any area of the building is turned over to PCC for acceptance and for beginning of the guarantee/warranty period, the systems and equipment shall be returned to the initial new condition such as; replacing used air filters with new air filters, cleaning the air side of all coils in the air handling systems, lubricating all bearings according to manufacturer's factory standards and adjusting control systems according to specifications and/or to suit PCC.
-
- Provision For Future Expansion and/or Installations
 - Where piping, ductwork and equipment is indicated for use in future expansion of the building and/or for future installations within the building, the Contractor shall leave sufficient clear space and install the piping, ductwork and equipment in such manner that connections to the future building expansion and/or future installations within the building can be made without removing existing floors, walls, ceilings. The Contractor shall consult with the Architect/PCC whenever necessary for this purpose.

Part 2 - Products

- No discussion.

Part 3 - Execution

- No discussion.

End of Section 23 00 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

Introduction

Acceptance testing during construction and achieving an acceptable final air and water balance are critical elements of project completion. It is therefore extremely important that the balancing and the associated report be accomplished and submitted before or at the time of substantial completion. Similarly, timely reviews by the Consultant/PCC will insure that the final balance is acceptable prior to occupancy.

Part 1 – General

- Ductwork Acceptance Testing
 - Test pressure for ductwork shall be at the design pressure class for the system.
 - The College may approve ductwork downstream of terminal units and ductwork with a design pressure less than 1 iwc via visual inspection.
 - Testing to be per the latest edition of The SMACNA Air Leakage Testing Manual. If requirements that are more stringent are required, discuss with Project Manager and include requirements in the project construction documents.
 - Orifice tube to be provided of appropriate size to show allowable leakage within the calibrated range of the tube.
 - All tests to be witnessed by PCC Inspector.
 - Chart for converting pressure to volume shall be specific for the device used in testing.
 - If sample testing is allowed – the test sections will be randomly selected by the PCC inspector from completed work.
- Piping Systems Acceptance Testing
 - Test all fire protection systems in accordance with all applicable NFPA Codes.
 - Piping to be inspected and pressure tested prior to insulation.
 - All pressurized piping systems tests to be for a 4-hour duration.
 - Gravity drainage systems test to be a 2-hour duration.
 - Pressure gauge for the test must have a suitable range such that the test pressure is in the middle 1/3 of the range.
 - All tests to be witnessed by PCC Inspector.
 - No loss of pressure allowed for all testing.
 - Gravity systems to be tested at 10ft hydraulic head or 5psig pneumatic if approved by the PCC Inspector and PCC Planning Department.
 - Domestic water to be tested at 100psig.
 - Mechanical hydronic piping shall be tested to 150 psig.
 - Laboratory gas piping to be tested at 150psig.
- Vibration Testing
 - Vibration testing to be performed on all rotating equipment 3 horsepower and above in accordance with AABC Standards.
 - Equipment shall have a maximum vibration velocity reading no greater than 0.04in/sec.
- Fume Hood Testing: Discuss With PCC Planning Design & Construction

- Each fume hood shall be identified with a plaque indicating the location and number of exhaust fan serving the hood.
 - Each exhaust fan shall be identified with a weatherproof plaque indicating the location(s) of the fume hood(s), by room number (s), that the fan serves.
- Air Systems
 - All work shall be in accordance with latest edition AABC, NEEB Standards and applicable sections of ASHRAE and SMACNA HVAC systems testing, adjusting and balancing procedures.
 - Air volumes measured shall be within $\pm 10\%$ of those shown on drawings unless otherwise specified for diffusers, grilles, registers where applicable and fans.
 - Ensure all temperature sensors and controls are calibrated prior to conducting test and balance procedures.
 - At the time of final inspection, recheck in the presence of the College and Design Professional, random selections of air quantities and fan data recorded in the certified report. Points or areas for recheck shall be selected by the College and Design Professional and be approximately 10% of the report data.
 - At the time of verification measure space temperature and humidity in a representative number of rooms to verify performance. Tabulate these results and bind into certified report as an appendix.
 - Testing to be conducted on a hierarchical principal, i.e. each piece of equipment for proper operation, followed by each sub-system followed by entire system, followed by inter-ties to other major systems.
 - Following final acceptance of the certified reports by the Design Professional, permanently mark the settings of all valves, dampers and other adjustable devices so that balance set position can be restored if disturbed at any time. Do not mark such devices until after final acceptance.
 - VFD controlled fan systems to be tested in bypass mode to verify satisfactory operation of static pressure high limit sensor.
- Piping Systems
 - Balance the entire water system to ensure all coils, heat exchangers, and etc., are operating to design conditions. Adjust the circuits by means of the balancing valves and record balance position.
 - Each pump shall be checked for design, working and shut-off head conditions and any pump that varies by more than 10% from the design conditions shall have the impeller trimmed or changed until design conditions have been met.
 - Flow through all heat exchangers, chillers, boilers and other such equipment shall be balanced to ensure that the pressure drop through the equipment is within 10% of the manufacturer's design conditions.
 - If the design conditions cannot be met by adjusting the balancing valves throughout the system, then pump impellers shall be either changed or trimmed as required.
 - Initial balancing of coils shall be to ensure that the pressure drops are within 10% of the manufacturer's design conditions. When both the air and water systems are fully operational, entering air and water and leaving air and water readings shall be taken as close as possible to the peak design conditions to ensure the coil performance meets the design conditions. Coil water working conditions shall only be taken in conjunction with the airflow working conditions for the coil.
 - Coordinate with the Contractor to ensure that all necessary valves for control and balancing are installed in all locations required. Notify the College and Design Professional in writing that this coordination has taken place. Include in this letter any recommendations made regarding valves, locations, installation, etc.
 - Testing to be conducted on a hierarchical principal, i.e. each piece of equipment for proper operation, followed by each sub-system followed by entire system, followed by inter-ties to other major systems.
 - Following final acceptance of the certified reports by the College and Design Professional, permanently mark the setting of all valves and other adjustable devices so that balance set position can be restored if disturbed at any time. Do not mark such devices until after final acceptance.

Part 2 – Products

- No Discussion.

Part 3 – Execution

- All required balancing shall be completed and the final report submitted as a condition of substantial completion.

End of Section 23 05 93

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 07 00 - HVAC Insulation

Insulation products associated with:

Piping & ductwork.

Part 1 - General

- Use wrapped supply ductwork, except in acoustically critical applications where liner may be used only after written permission is given by the College. Lined ducts shall not be used in medical areas, clean rooms, or all high velocity supply ductwork.
- These requirements apply to building and tunnel piping. For direct buried chilled water piping, discuss with the College.

Part 2 - Products

- Pipe Insulation Schedule (minimum insulation thickness)

Fluid Design Operating Range (°F)	Conductivity Range Btu•in./(h•ft ² •°F)	Mean Rating Temperature °F	Nominal Pipe Diameter (in.)				
			Less than 1"	1 to 1 ½"	1 ½" to 4"	4" to 8"	8" and larger
Above 350°F	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0
251-350°F	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201-250°F	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141-200°	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105-140°F	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
56 - 104°F	No Insulation Required						
40-55°F	0.21 – 0.27	75	0.5	1.0	1.0	1.0	1.0
Below 40°F	0.20-0.26	50	1.0	1.0	1.0	1.0	1.5

Note: For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r\{(1 + t/r)K/k - 1\}$ where T = minimum insulation thickness (in.), r = actual outside radius of pipe (in.), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu•in./h•ft²•°F); and k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

- Chilled Water Piping
 - All branch lines that are final connections to equipment 2" and below, valves, strainers and other piping appurtenances shall be insulated with closed cell foam insulation. Application shall be per Armaflex North American Application Manual. Extra care shall be taken to maintain the required Vapor barrier to prevent condensation.
 - All exposed metal surfaces shall be insulated when located above ceilings.
 - All chilled water ball valves operating below dew point are to be provided with insulated tee-handles such as NIBCO NIB-SEAL, Apollo Therma-Seal or equivalent.
 - Chilled water mains shall be insulated with fiberglass pipe insulation per schedule and applied per all manufacturer's instructions for piping operating below 45 degrees except tempered chilled water above dew point in chilled beam applications.
- Duct Insulation (minimum)

- 2" fiberglass with foil back wrap with a minimum density of 0.75 lb./ft³.
- 1" fiberglass duct liner with heavy-duty surface, (see Part 1 - General).
- Exterior ductwork to be insulated and lagged with aluminum jacketing.

- Pipe Insulation Jacket
 - Interior concealed - fiberglass, All Service Jacket (ASJ). PVC jacket for chilled water in indirectly conditioned or potentially humid spaces.
 - Interior exposed or in equipment rooms
 - Cover hot piping less than 10 feet above finish floor with 8 oz. canvas jacket sealed with water based lagging adhesive and sizing compound, like Foster 30-30.
 - Chilled water piping- cover with PVC jacket.
 - Tunnel piping
 - Steam and condensate - Canvas jacket sealed with water based lagging adhesive and sizing compound, like Foster 30-30
 - Chilled water - PVC jacketed
 - Exterior piping - fiberglass ASJ covered with embossed aluminum jacket with banding at joints and sealed with 25-year clear silicone.
 - Any insulated pipework installed within an air-handling unit to be covered with PVC jacket.

- Equipment Insulation
 - Rigid, foil faced, fiberglass with a minimum density of 3.0 lb./ft³. Cold equipment (where fluid temperature is below 50 degrees F) shall be insulated with closed cell foam insulation. (Aramaflex or equal Misc. Product).

- Closed cell foam insulation that meets smoke developed/flare spread ratings of 50/25 may be used where allowed by the code.

Part 3 - Execution

- Provide fitted insulation that can be removed and reused around equipment, valves, flanges, and etc.
- Use Z-strips on all leading edges of duct liner, (when permitted).
- Insulated fittings, i.e., elbows, tees, Y's to be packed and fitted with PVC covers or pre-molded insulation and PVC covers if applicable.
- Install insulation per Manufacturers Installation Manual and latest edition MICA Standards.
- Use welded pins for ductwork insulation attachment. No mechanical or glued attachments allowed.
- For pipe sizes greater than 1¼", provide calcium silicate inserts and metal shields to protect the insulation at each support. Provide solid inserts for smaller pipe sizes.
- Domestic hot water piping shall be insulated.
- Cooling system condensate drain lines shall be insulated where pipe is subject to potential sweating, including roof and area drains carrying condensate.
- Piping carrying fluid below 65°F and all steam piping to be insulated continuously through clamping, support and sleeving.

- All supply ductwork to be insulated - Ductwork downstream of terminal boxes exposed within the conditioned space may be uninsulated.

END OF SECTION 23 07 00

DIVISION 23 – Heating, Ventilating, and Air Conditioning (HVAC)

Section 23 09 23 - Direct-Digital Control System for HVAC

I. Introduction

- A. Pima Community College employs and maintains an Energy Management Control System (EMCS) that consists of building automation, integration, and controls hardware, software, tools, and systems. The EMCS is critical to the operation of College facilities. It provides:
1. Comfort control & automation
 2. Energy efficiency
 3. Remote monitoring and control
 4. Operational trend data for analysis
- B. This section describes Energy Management Control System and System Integration requirements for Pima Community College projects. This section also coordinates the responsibilities of the Mechanical and Electrical trade contractors pertaining to control products or systems furnished by each trade that will be integrated by this division. See Tab B11 – BAS Object Naming Standard, which describes EMCS networks and cabling.
- C. It is the goal of Pima Community College to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. All proposals, submittals, products, and workmanship shall reflect that goal.
- D. Pima Community College uses Smart Building Technology Standards to specify a modern, high-performance EMCS model. This section will:
1. Communicate Smart Building Technology Standards to project managers, engineers, technicians, contractors, vendors, and service providers.
 2. Describe technology standards that facilitate simplified, automated, streamlined, scalable, repeatable, and consistent implementation of technology.
 3. Ensure that technology systems are compatible in terms of functionality, interoperability, integration, data archival and analysis, and security.
 4. Eliminate duplication of effort by leveraging infrastructure and using common standards, allowing building systems to connect to each other and to enterprise systems in a standardized manner with minimal effort.
 5. Describe processes used to plan, implement, and commission technology devices and systems in Pima Community College facilities.
 6. The use of JACES, gateways, or additional panels to interpret, transfer or manage data or communications from equipment controllers is not allowed on the Pima College HVAC network. New controllers connected to the Pima College HVAC network MUST communicate with the existing front end, and MUST communicate directly with the contractor provided system backup server located at Pima College District Office.

E. Systems not in the scope of Section 23 09 23:

1. Energy Metering - see Section 40 71 00 – Flow Measurement for metering design specifications and requirements
2. Security/Access Control
3. Life Safety/Fire Alarm
4. Elevators
5. Digital Signage
6. Irrigation

F. Abbreviations:

1. PCC = Pima Community College
2. EMCS = Energy Management Control System
3. BAS = Building Automation System (synonymous with EMCS)
4. DDC = Direct Digital Control
5. GUI = Graphical User Interface
6. SOO = Sequence of Operation
7. AHU = Air Handling Unit
8. VFD = Variable Frequency Drive

II. Technology Planning

- A. The Energy Management Control System (EMCS) shall be Direct Digital Control (DDC), fully automatic, with electric and electronic components as required. Actuation shall be electronic in new or retrofit work. EMCS technology shall provide and/or support the concepts of open, distributed design, interoperability, accessibility, and security. The EMCS architecture consists of three layers:

1. Control Layer

- a. The Control Layer is made up of building automation control devices. These devices control and monitor various equipment, such as (but not limited to) HVAC, lighting, and laboratory equipment. BACnet communications protocol shall be utilized to ensure direct interoperability between all devices within the building network. See section III, B for BACnet implementation details.
- b. This layer includes routers that convert a BACnet protocol from serial to IP.
- c. Devices on this layer control the actual equipment. System design shall be capable of stand-alone operation, defined as operating the equipment in a safe and effective manner even when completely disconnected from the network. This mode of operation may not be able to achieve all aspects of the sequence of operation (SOO), but it shall still operate the equipment under a basic

control scheme achievable with the local inputs and outputs available to the controller while operating under stand-alone circumstances. All control loop inputs, outputs, and logic shall reside in the same controller, allowing for stand-alone functionality. An alarm shall always be generated and sent to the EMCS monitoring system operator(s) when a controller or other networked device is not connected to the network. During stand-alone mode, controlled equipment shall continue operating as prior to the communication interruption in a manner that does not require input from remote devices. Where continuous uninterrupted operation is not desired, the equipment shall instead revert to a safe position.

- d. Major equipment (AHUs, heat exchangers, hydronic systems, etc.) controllers shall be IP-based, unless by written permission allowing BACnet MS/TP communication, and will connect to Pima Community College network environment. All major equipment controllers, sensors, and actuators shall be electronic.
 - e. Minor equipment (terminal units, fan coils, heat pumps, etc.) controllers may use MS/TP technology, and must be connected via IP controller or router to Pima Community College network. All minor equipment controllers, sensors, and actuators shall be electronic.
 - f. Provide electronic speed control for variable volume systems. Electronic speed control devices shall communicate using BACnet. See Section III, B for details.
 - g. Wireless technology is not preferred. Wireless systems that are installed shall operate error-free for the entire warranty term, or shall be replaced with a hardwired system at no cost or disruption to Pima Community College.
 - h. System shall have a minimum of 10% capacity expansion within the current equipment. System design shall be modular to ensure future expansion capabilities, whether it be additional control/monitoring points or supervisory functions.
2. Integration Layer
 - a. All devices added to the Pima Community College EMCS system must be BACnet. Written authorization is required for possible exceptions.
3. Enterprise Layer
 - a. The Enterprise Layer connects to the Control Layer either directly or through the Integration Layer. It hosts the global Graphical User Interface (GUI), trend data consolidation and visualization, programming tools, and global supervisory control.
- B. EMCS technology shall be connected to or shall reside on Pima Community College network. Ad hoc IP networks are not permitted.
1. Pima Community College connectivity may not be available or ready for device connection at the time of controls startup during the course of a project. The controls contractor shall install a temporary IP network to support EMCS devices until Pima Community College makes the permanent network available. The controls contractor shall use 10/100 cabling that meets or exceeds Pima Community College requirements, and shall coordinate with Pima Community College to run temporary network cable to the correct IT switch locations, enabling Pima Community College to re-use the cabling. Temporary switches shall be provided and used by the controls contractor, and shall be removed by the controls contractor when all devices have been migrated to Pima Community College network. All cabling shall be labeled according to Pima Community College standards.
 2. For software-only products, generally Pima Community College will supply a virtual server to host the

application. Workstation software generally will not be required unless specifically noted in the scope of work, since most workstation clients will be web-based and will not require application software running on the workstation. The contractor shall coordinate with Pima Community College for provisioning of servers.

3. In cases where an application is required to run on a workstation (such as for field configuration or programming tools), the contractor shall work with Pima Community College to coordinate the logistics and provisioning as appropriate for the project.
- C. EMCS alarm data shall flow from the BACnet field devices to the Enterprise layer interface as follows:
1. Alarm Configuration:
 - a. Alarm events shall be created in the local BACnet devices, each assigned to the appropriate alarm class. Alarms events shall be created in local B-BC or B-AAC devices for alarm points that are located in packaged B-ASC-type devices to allow those alarms to be routed properly.
 - b. Alarm description text shall be completed to describe alarm condition.
 - c. Appropriate alarm conditions, deadbands, and delays shall be used to avoid nuisance alarms.
 2. Alarm Classes:
 - a. Control Layer:
 - 1) "XXXX_StandardAlm" (where "XXXX" is the building number)
 - 2) "XXXX_CriticalAlm" (where "XXXX" is the building number)
 - 3) "LocalAlm"
 - b. Integration layer:
 - 1) "XXXX_StandardAlm" (where "XXXX" is the building number)
 - 2) "XXXX_CriticalAlm" (where "XXXX" is the building number)
 - 3) "LocalAlm"
 - 4) "DeviceAlm"
 - c. Enterprise Layer:
 - 1) "XXXX_StandardAlm" (where "XXXX" is the building number)
 - a) A separate "StandardAlm" alarm class shall be created for each building
 - 2) "XXXX_CriticalAlm" (where "XXXX" is the building number)
 - a) A separate "CriticalAlm" alarm class shall be created for each building
 - 3) "DeviceAlm"
 - 4) "StationAlm"
 3. An object list shall be submitted to Pima Community College from which alarm events will be identified and classified, and then will be returned to the contractor for implementation. Basic alarm guidelines are shown in the table below:

Object	Alarm State	Deadband	Alarm Conditions(s)	Delay	Alarm Class	Notes
RmTmp	> or < RmTmpSp	+/-5°F	Occupied Times	30m	StandardAlm	
RmRelHum	> or < RmRelHumSp	+/-15%	Occupied Times	30m	StandardAlm	
Cmd/Sts	Cmd on, Sts off	N/A	Any	90s	LocalAlm	
SATmp	> or < SATmpSp	+/-10°F	When SFSts is On	15m	StandardAlm	if there is no Sts point, use SFCmd
SASTprs	> or < SASTprsSp	+/-0.5' WC	When SFSts is On	15m	StandardAlm	if there is no Sts point, use SFCmd
Alm {any}	on	N/A	Any	None	LocalAlm*	*default - depends on application
CHWSTmpAlmH	on	N/A	Any	15m	CriticalAlm	
HWSTmpAlm	> or < HWSTmpSp	+/-20°F	Any	15m	CriticalAlm	
HWSTmpAlmH	>190	N/A	Any	None	CriticalAlm	
Device	Down	N/A	Any	30m	DeviceAlm	

4. Local Alarms (LocalAlm):

- a. These alarms are configured and assigned to the "LocalAlm" alarm class, and are not routed beyond the local controller or integration device.

5. Standard Alarms (XXXX_StandardAlm):

- a. These alarms are configured and assigned to the "StandardAlm" alarm class, and are routed to the Enterprise Level.

6. Critical Alarms (XXXX_CriticalAlm):

- b. These alarms are configured and assigned to the "CriticalAlm" alarm class, and are routed to the Enterprise Level.
- c. Contractor shall request from the College information regarding which alarms should be considered "critical", and shall assign those alarms to the "XXXX_CriticalAlm" alarm class.

7. Nuisance Alarms:

- a. Alarm tuning shall be performed to eliminate nuisance alarms. Nuisance alarms are defined as alarms that are triggered under conditions that are unintended, triggered under conditions that do not require attention, trigger too quickly without allowing conditions to stabilize, trigger repeatedly for the same event, or are routed incorrectly.

8. Alarm Notifications:

- a. Alarm management consoles:
 - 1) For each building, "XXXX_StandardAlm_Console" and an "XXXX_CriticalAlm_Console" shall be created on the Enterprise server. Alarms shall be routed to each accordingly.
 - 2) Device and Station "down" alarms shall be routed to "DeviceAlm_Console"

and "StationAlm_Console" respectively on the Enterprise server.

- 3) "LocalAlm" alarm class events are routed to the local alarm console in the building, if there is one.

- D. Equipment schedules be standardized BACnet Schedule Objects, and shall reside in the local BACnet field devices. The Enterprise user interface shall be capable of modifying, enabling, and disabling the equipment schedule objects.

III. Product Specifications

EMCS Layer Product Specifications:

1. Control Layer

- a. All Control Layer products shall be BACnet-compliant and BTL-certified. If the project is within an existing building, then, depending on the scope of the project, the communication protocol may match existing, pending Pima Community College approval. See BACnet requirements in Section III, B.
- b. Approved products:
 - 1) Delta Controls (BACnet)
 - 2) Others only with written approval
- c. All software and firmware for all products shall be the latest stable version available on the date of substantial completion.
- d. Noise, surge and spike protection requirements, at minimum:
 - 1) Operating Voltage: 120 VAC
 - 2) Clamping Voltage: 325 VAC
 - 3) Operating Current: 15A
 - 4) Peak Surge Current: 13 kA/Mode, 26 kA/Phase, 39 kA/Total
 - 5) Operating Frequency: 60 Hz
 - 6) EMI Attenuation: > 40 dB
 - 7) Modes of Protection: Line-to-Neutral, Line-to-Ground, Neutral-to-Ground
 - 8) Status Indication
 - 9) Vibration-resistant Screw Terminal Connections
 - 10) Terminals must accept up to 14 AWG
 - 11) Operating Temperature: -40°C to +85°C
- e. All EMCS devices controlling major equipment (heating/cooling pumps and heat exchangers, air-handling units) shall be powered using battery backup (UPS) sufficient to power critical devices for at least fifteen (15) minutes. Battery backup and loads fed from battery shall be wired using standard 120 VAC receptacle plugs to facilitate simple bypass in case of battery failure. UPS device shall incorporate surge protection as outlined above.
- f. Memories shall be non-volatile, or unit shall hold memory up to 30 days minimum on backup batteries.
- g. All CV and VAV terminal unit controls shall be DDC application-specific type (B-ASC) for new building construction and retrofit work.
- h. All control valves with a nominal opening diameter of 2" and smaller shall be ball valves. Valves

greater than 2" shall be globe valves.

- i. Use manual-reset freeze stats.
- j. Humidity sensors:
 - 1) Input Voltage Range: 6 to 30 VDC
 - 2) RH Range: 3% RH to 95% RH
 - 3) Accuracy: $\pm 2\%$ RH
 - 4) RH Signal Output: 4 to 20mA for 0 to 100% RH
 - 5) Repeatability: $\pm 1\%$ RH
 - 6) NEMA 4 enclosure
- k. Monitor all central utilities and emergency systems from a local and remote location. See Section 40 71 00 for metering details and requirements.
- l. Required Control Objects:
 - 1) Chilled water flow (gpm), totalized energy (btu)
 - 2) Chilled water header differential pressure (psig)
 - 3) Heating Hot water flow in GPM, totalized energy in btu's
 - 4) Domestic Hot water flow in GPM totalized in btu's
 - 5) Domestic water totalized in gallons
 - 6) Electric use totalized in kW hrs
 - 7) Real time demand in kW
 - 8) Individual equipment power and energy use where required by Pima Community College
 - 9) Chilled water supply and return pressure and temperatures
 - 10) Steam pressures
 - 11) Domestic water pressures
 - 12) Hot water supply and return pressure and temperatures
 - 13) Status of equipment pumps and drives
 - 14) Change of set point capability for all variable frequency drives
 - 15) Provide HVAC equipment greater than 1 HP with time scheduling capability via EMCS
 - 16) Reset of hot water supply temperatures
 - 17) Chiller operational status, run times, pressures and temperatures
 - 18) Cooling tower operational status and temperatures
 - 19) Report of any EMCS component failures on critical equipment as required by Pima Community College
 - 20) Emergency generator-run time, load, kW, kVA
 - 21) Alarms as specified in other sections
 - 22) All control objects specified or suggested by the sequence of operations for each piece of equipment or system
- m. Individual Unit Characteristics:
 - 1) Air Handling Unit fan status, start/stop, and fan speed (where applicable)
 - 2) Supply air, return air, and mixed air temperatures
 - 3) Return air relative humidity (expressed as dew point temperature)
 - 4) Demand reset of hot and cold decks (based on zone terminal unit demand)
 - 5) Economizer control (enthalpy-based)
 - 6) Chilled water return temperature control
 - 7) Lighting controls (where specified)
 - 8) Occupancy reset of temperature and system shutdown (scheduled and/or via sensors)
 - 9) Filter differential pressure indication
 - 10) Space humidity status and reset when specified

- 11) High-limit humidity control (dehumidification mode)
 - 12) Status of hot and cold duct static pressure
 - 13) Demand reset of duct static pressure (based on zone terminal unit damper positions)
 - 14) Active control strategy for maintaining ventilation and indoor air quality requirements (e.g.: CO2 sensing, outdoor airflow measurement)
- n. Terminal Unit Characteristics:
- 1) Adjustment of flow set points (min and max)
 - 2) Override of temperature set point
 - 3) Occupied and Unoccupied setpoints for flow and temperature
 - 4) Adjustable dead-band
 - 5) Discharge air temperature
 - 6) Valve position
 - 7) % cooling load
 - 8) % heating load
 - 9) Current air volume set point
 - 10) Current air volume
- o. Provide a single building outdoor air station that measures temperature and relative humidity. (This station will be used for all building reset and AHU mode decisions, i.e.: economizer, dehumidification.) This station must be installed on the North side of the facility out of direct sunlight in a location that will not be affected by influences other than actual ambient air conditions, such as exhaust air, radiant heat from nearby objects, reflected radiant heat, evaporation, vandalism, or other confounding factors.
- 1) Dew point temperature is to be used for humidity control actions not relative humidity.
- p. Provide airflow measuring stations as required. Provide Ebtron Gold air flow measuring stations.
- q. All control valves and isolation valves are to be located outside the Air Handler enclosure (not in the airstream).
- r. Chilled water control valves to fail to "open" position. Hot water control valves to fail to "closed" position.
- s. Provide adequate space to install all control valves with stems in the vertical position without exception.
- t. Provide adjustable static pressure safety switch to shut down VFD controlled fans.
- u. Identify all controls and wiring within pertinent control panel and provide control system drawing framed under Plexiglass or laminated on inside of panel door.
- v. Provide alarms for critical control objects & conditions. Alarms shall be enunciated at the enterprise server. While other alarms may be required or specified, standard alarms shall include (where applicable):
- 1) Command failure (where status is available):
 - a) Fans
 - b) Pumps
 - c) Equipment

- 2) Excessive deviation from set point:
 - a) Supply air temperature
 - b) Space temperature
 - c) Building static pressure
 - 3) High temperature limit:
 - a) Heating hot water
 - b) Chilled water
 - c) Domestic hot water
 - 4) Low temperature limit:
 - a) Heating hot water
 - b) Chilled water
 - c) Domestic hot water
 - d) Mixed air temperature
 - 5) Equipment fault:
 - a) VFD fault
 - b) Photovoltaic inverter fault
 - c) Chiller fault
 - d) Boiler fault
 - e) Generator fault
 - f) Refrigeration unit fault
 - 6) Safety devices
 - a) Filter status switch
 - b) Low temperature detector (freeze stat)
 - c) High static pressure switch
 - d) Flood/moisture sensor
 - e) Condensate pan float switch
 - f) Smoke/fire alarm
 - g) Occupant panic button
 - h) Refrigerant detector
 - i) Hazardous gas level
 - 7) Laboratory environment
 - a) Room pressurization error
 - b) Space temperature high/low
 - c) Space humidity high/low
 - d) Exhaust system fault
 - e) Fume hood control fault
- w. PID Loop Tuning Requirements:
- 1) Definitions:
 - a) Process variable (Pv): the system parameter the loop is designed to control (i.e.: temperature, pressure, etc.)

- b) Control variable (Cv): the means of affecting the Process variable (i.e.: valve, damper, VFD, etc.)
 - c) Set point (Sp): the desired value of the Process variable
 - d) Error: the difference between the Set point and the Process variable
 - e) PID: Proportional, Integral, and Derivative mathematical terms
 - i. P calculates the response for current error
 - ii. I calculates the response for historical error
 - iii. D calculates the response based on rate of change
 - f) Bias: Used in P-only loop controllers, Bias compensates for steady- state error
 - g) Deadband: defines a Pv range within which the Cv will not be adjusted by the PID controller
- 2) Specific commissioning tasks:
- a) Identify required control loops and loop variables.
 - b) Tune all loop controllers.
 - c) Review data showing Pv maintained at Sp.
 - d) Review data showing system startup & stabilization.
 - e) Review data of system upset & recovery.
 - f) Document results.
- 3) Methods of performance:
- a) Pv, Cv, Sp, PID gains, Deadband, and Error properties shall be visible and adjustable while the loop is active.
 - b) Separate PID terms shall be used for different modes of operation (i.e.: heating, cooling, economizer) to avoid linearity issues; each mode shall be tuned individually.
 - c) Loop controller shall use P, I, D, Bias, and Deadband as-needed to provide control within the required parameters.
 - d) Loop control shall display:
 - i. Stability: the Pv shall be maintained in a stable state.
 - ii. Set point tracking: the Pv shall match the Sp, reducing Error to within the acceptable range (see below).
 - e) Loop control shall not display:
 - i. Hunting/oscillation:
 - a. Patterns of hunting or oscillation shall not be exhibited by the loop controller.
 - ii. Excess Error:
 - a. Temperature Control: Error must be $< 2^{\circ}\text{F}$.
 - b. Humidity Control: Error must be $< 10\%$.
 - c. Static Pressure Control: Error must be $< 0.10'' \text{ WC}$.
 - d. Hydronic Pressure Control: Error must be $< 5 \text{ PSI}$.
 - e. Air Volume Control: Error must be $< 10\%$.
 - f. Hydronic Volume Control: Error must be $< 10\%$.
 - iii. Gross overshoot:
 - a. Upon Sp change or load upset, Pv shall not be allowed to overshoot Sp by $\pm 10\%$ of stated Pv range.
 - iv. Excessive Cv action:
 - a. When Pv is stable, Cv shall adjust no more than 5% per minute (total action in both directions).
 - v. Sluggishness:
 - a. Upon equipment startup, the loop controller must bring Pv to stable control within the allowable Error within 20 minutes.
 - b. Upon Sp change or load upset, the loop controller must return Pv to stable

control within the allowable Error within 5 minutes.

- 4) Documentation and reporting criteria for each control loop shall be provided by contractor:
 - a) Identify parameters:
 - i. Control Loop Identifier and equipment served
 - ii. Pv object & Pv range
 - iii. Cv object & Cv range
 - iv. Sp object & Sp range
 - v. PID terms & values
 - vi. Bias term & value (if applicable)
 - vii. Deadband (if applicable)
 - b) Data graph of loop behavior on startup for each applicable mode:
 - i. Graph must show actual data of:
 - a. Initial conditions: Equipment off, Cv in safe position
 - b. Equipment Start: Sp value, Cv action, Pv response
 - c. End conditions: Stable Pv within allowable Error
 - d. Time elapsed between Initial and End conditions
 - c) Data graph of upset & recovery under load for each applicable mode:
 - i. Graph must show actual data of:
 - a. Initial conditions: Stable Pv within allowable Error
 - b. Upset: Sp change (10% of Pv range) and Cv action
 - c. End conditions: Stable Pv within allowable Error
 - d. Time elapsed between Initial and End conditions

3. Enterprise Layer

- a. Pima Community College operates and maintains an integrated open-protocol environment that allows BACnet products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system.
- b. EMCS and GUI software (Enterprise Software) shall provide an essential window into the open environment, serving as the primary user interface for all open-protocol systems. All vendors providing Pima Community College with open-protocol products and systems will use this Enterprise Software. All software and firmware for all products shall be the latest version available at the date of substantial completion.
- c. The Enterprise Software shall be installed in a Pima Community College-provided virtual environment. The contractor shall provide minimum and recommended system requirements.
- d. The Enterprise Software shall be a BACnet Client, and shall be capable of performing the functions of a BACnet Advanced Workstation (B-AWS). The software shall be capable of simultaneously supporting BACnet/IP communications on several different UDP ports and networks.
- e. Enterprise Software functionality requirements:
 1. The Enterprise Software shall have the ability to collect data for any property of any object and store this data for future use. The Enterprise Software shall also be configured to archive trend data collected by devices supervised by the Enterprise Software.
 2. All log data shall be available to the user in the following data formats:

- a) Table (HTML)
 - b) Graph (HTML)
 - c) Comma separated values (CSV) export
3. Pima Community College uses the Alerton Compass as a standard GUI. New graphics supporting new and retrofit installations must be created in the Compass environment.
 4. Graphic screens shall be properly labeled with similar systems appearing the same.
 5. Each Integrator or contractor is responsible for maintaining continuity within the system. All pages must be formatted for 1550 x 800 dpi.
 6. All Graphic elements created by any one integrator or contractor must be stored on the server for use by all other integrators and contractors.
 7. All Graphic elements created by any one integrator must be stored on the server for use by all other integrators and contractors.
 8. Hotlinks to sites outside of the Pima CC Firewall are not allowed.
1. Event Alarm Notification
 - a) The Enterprise Software shall be configured to generate alarms for Enterprise Software and BAS device errors, and other conditions that may lead to outages, failures, performance issues, or trend data loss.
 - b) Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - 1) To alarm
 - 2) Return to normal
 - c) Create a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: supervisory, EMCS device failure, security, HVAC, Fire, etc. Submit alarm classes to Pima Community College for approval.
 - d) Provide routing of alarms by class, object, group, or node. Provide alarm escalation functionality.
 - e) Provide alarming for all IP-connected BAS devices.
 - f) Alarms shall be enunciated via email to one or more recipients.
 - g) The following shall be recorded by the Enterprise Software for each alarm (at a minimum):
 - 1) Time and date
 - 2) Location
 - 3) Equipment/Device
 - 4) Acknowledge time, date, and user who issued acknowledgement.
 - 5) Number of occurrences since last acknowledgement.
 - h) A log of all alarms shall be maintained by the Enterprise Software and shall be available for review by the user group.
 - 1) Provide features to allow filtering/routing of alarms by user defined parameters.
 - 2) A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
 - 3) An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
 - i) Alarms shall be created to notify operators of operating conditions that require immediate corrective response only. Conditions that do not warrant immediate, specific action shall not have alarms associated. Alarm event notification shall include information to indicate the specific action that is required.

- j) Nuisance alarms, defined as false and/or repetitive notifications where no immediate corrective response is required, shall be reconfigured in a manner that eliminates false/repetitive alarms while preserving functionality required to alert Pima Community College
 - 2. Provide and maintain an Audit Log that tracks all operator activities that are performed on the Enterprise Software system. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. For each log entry, provide the following data:
 - a) Time and Date
 - b) User ID
 - 3. The Enterprise Software shall be configured to automatically and regularly backup its configuration database. The database shall be backed up based on a user-defined time interval to itself and a remote server.
 - a) Copies of the current configuration database and the most-recently- saved database shall be stored in the Enterprise Software. The age of the most recently saved database is dependent on the user-defined database save interval. The last three (3) backups shall be retained.
 - b) The Enterprise Software shall be configured to collect and store copies of the configuration backup for each of the devices it supervises. (Controllers cannot be reloaded from other field mounted control devices.)
 - 4. A standard library of objects, templates, and GUI clip-art shall be included for development and setup of application logic, user interface displays, system services, graphics, and communication networks.

b. Data Model

- 1. Data from various sources must be normalized under a common data model (schema). All data entries must include:
 - a) Date/time stamp in standard format
 - b) Object name
 - c) Value
 - d) Engineering units
 - i. any unit codes must be decoded into English text
 - e) Object status (normal = 1/failed = 0, where available)
 - i. Normal = 1
 - ii. Failed = 0
 - iii. Object status should be incorporated into recorded value by dividing the value by the status:
 - a. $72^{\circ}\text{F}\{\text{ok}\} = 72/1 = 72$
 - b. $72^{\circ}\text{F}\{\text{fail}\} = 72/0 = \text{nan}$ (not-a-number)
 - c. $72^{\circ}\text{F}\{\text{fail}\} = 72/0 = \text{null}$
 - iv. Values recorded for failed objects shall be distinguishable from valid values.

c. Engineering

- 1. Database shall be distributable across disks, servers, and data centers, and logically optimized for network efficiency.
- 2. Database shall be open-protocol or open API to accommodate future needs and applications.
- 3. Database shall have configurable redundancy features.

4. Database shall be repairable and upgradable without causing system downtime.
5. Disaster recovery (DR) options shall be outlined for system and data. DR setup shall be supported by vendor as-required to facilitate DR implementation and testing.

d. Maintenance

1. Operational uptime for the system must be 99.9% (8 hours of downtime allowable annually)
2. System or accessibility downtime caused by data storage failure must be 0 minutes.
3. Support and development resources must be available in the marketplace.
4. Maintenance and support must be transition-able to Pima Community College.

e. Security

1. System software must meet Pima Community College security requirements.
2. System must be capable of granting data access permissions to users and user-types on a per-facility and per-user basis.
3. System must be hardened for security.

B. BACnet Implementation & Deployment Specifications

1. BACnet Definitions

a. BACnet: ANSI/ASHRAE Standard 135-2012

b. BACnet Device Types:

1. BACnet Router (B-RTR): A device that connects two BACnet networks, permitting information exchange between them.
2. BACnet Building Controller (B-BC): A general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks. Typically controls major equipment and/or provides supervisory control.
3. BACnet Advanced Application Controller (B-AAC): A fully programmable controller.
4. BACnet Application Specific Controller (B-ASC): A controller intended for use in a specific application with limited programmability. Typically controls minor equipment such as VAV terminal units.
5. BACnet Smart Sensor (B-SS): A simple sensing device intended for a specific application.
6. BACnet Smart Actuator (B-SA): A simple control device intended for a specific application.
7. BACnet Advanced Work Station (B-AWS): Used to monitor the performance of a system and to modify parameters that affect the operation of a system.
8. BACnet Operator Work Station (B-OWS): Used for monitoring and basic control of a system.

9. BACnet Operator Display (B-OD): A basic operator interface with limited capabilities.
 10. BACnet Gateway (B-GW): A device that connects a BACnet network to a dissimilar network or device, permitting information exchange between them.
 11. BACnet Broadcast Management Device (BBMD): A device that propagates BACnet broadcast services from one network to another network.
- c. BACnet Client: A BACnet device requesting information from and/or sending supervisory commands to a BACnet Server or BACnet Servers.
 - d. BACnet Server: A BACnet device that responds to requests and/or supervisory commands from a BACnet Client device.
 - e. BACnet Interoperability Building Blocks (BIBBs): Standard technical functionality blocks used to describe the capability of a device to interact with BACnet services. Each BIBB has a client version (A) and a server version (B). A single BACnet device can support both A and B versions of BACnet Interoperability Building Blocks (BIBBs).
 - f. BACnet Protocol Implementation Conformance Statement (PICS): Document that describes in technical detail the BACnet implementation applied to a device, including which BACnet Interoperability Building Blocks (BIBBs) apply to the device.
 - g. Native-BACnet: A controller that uses BACnet as the primary communication protocol, and does not require the use of a gateway or translator to be BACnet-compliant.
 - h. BACnet Testing Laboratory (BTL): A laboratory that tests and certifies BACnet devices for conformance to the BACnet standard.
 - i. Bounded/Unbounded: An unbounded broadcast refers to a BACnet broadcast that is sent to all BACnet device IDs on the entire internetwork. A bounded broadcast is sent only to a subset of device IDs. Unbounded confirmed broadcast messages can result in BACnet storms. Bounded confirmed broadcast services mitigate the risk of storms by reducing the scope of the communications to only those devices that are specified, which limits the number of potential responses.
2. Documenting BACnet in Proposals, Submittals, and As-Built Records
 - a. Clear communication regarding BACnet is essential. Therefore, all documentation and literature shall refer to BACnet topics and concepts using standardized terminology. Refer to ANSI/ASHRAE Standard 135 for proper terms.
 - b. Any documentation that does not meet the terminology requirements or fails to include the required information will be rejected.
 - c. All approved BAS system submittals shall include all pertinent information relating to BACnet including:
 - 1) Controller schedule including all BAS controllers to be used; include an electronic spreadsheet including:
 - a) Controller name/description
 - b) Manufacturer
 - c) Model number
 - d) Software Version

- e) Firmware Version
 - f) BACnet device type (i.e.: B-BC, B-AAC, B-ASC, etc.)
 - g) BACnet network type (BACnet/IP or BACnet MS/TP)
 - h) Location (room number or description of installation location)
 - i) Controlled Equipment
 - j) MS/TP network(s) supported (where applicable)
 - k) Host controller (for MS/TP devices, where applicable)
- 2) BAS architecture diagram specific to the planned installation (no generic diagrams) including:
 - a) Logical network topology for all networks
 - b) Nomenclature to identify each device and network matching nomenclature in controller schedule
 - 3) Product data sheets for all products provided.
 - 4) Operation & Maintenance manuals for all products provided.
 - 5) Technical manuals for all products provided.
 - 6) BACnet PICS for each product included in design.
 - 7) Device and object names shall conform to Tab B11 – BAS Object Naming Standard.
 - 8) Request for information (RFI) regarding IT and BACnet parameters required for configuration of devices. Logical diagram and controller schedule must be updated incorporating network configuration information and re-submitted for approval.
- d. All accepted BAS system as-built documentation shall include all pertinent information relating to BACnet including:
 - 1) Submittal schedules, diagrams, and drawings updated with IT and BACnet parameters obtained from Pima Community College.
 - 2) Updated architecture diagram including IT network details and BACnet parameter details.
- e. PICS shall include at minimum:
 - 1) BACnet Standard Application Services Supported: This table confirms the BACnet services supported by the device.
 - 2) Standard Object Types Supported: This table lists the devices supported object types. It also indicates if the object is dynamically creatable, dynamically delete- able, optional supported properties, and writable properties.
 - 3) Data Link Layer Options: Describes the network types supported for communications, e.g., Ethernet, IP, or MS/TP.
 - 4) Special Functionality: Describes any special exceptions the device may have to the BACnet protocol in order to perform any specific functions.
 - 5) Property Range Restrictions: Indicates, among other things, the number of characters allowed for the various text properties, such as Object Name and Description.

- 6) The project technical specifications should act as the submittal review criteria. The information provided by the PICS should be compared to the technical specifications to ensure the device will function in the system as intended by the design.

3. BACnet Services

a. Normal Services (directed to a specific BACnet device or devices)

b. Broadcast Services (directed to any/all BACnet devices)

1) Who-is?

a) The Who-is? service is to be used in limited ways to avoid BACnet storms:

- i. Unbound discovery is prohibited; use bounded Who-is?
- ii. Messages to limit responses.
- iii. Who-is? shall not be required for daily operation of the BAS or integration system; Who-is? is a discovery tool only. System devices are required to cache device discovery information and use directed communications to achieve interoperation.
- iv. Any system or device incapable of controlling and/or disabling Who-is? broadcast services it is capable of initiating will not be accepted.

2) Who-has?

a) The Who-has? service shall not be used in normal day-to-day operation; system devices are required to cache object locations and use directed communications to achieve interoperation.

- i. A device may use Who-has? to initially gain access to a network object, but thereafter this information shall be cached.
- ii. System devices shall not re-issue Who-has? on a return from power failure or other system disruption. Device or system backups shall retain cached object locations. Who-has? is permitted only in cases of programming changes.
- iii. The system must be capable of disabling the Who-has? service.
- iv. The system must be capable of configuring the Who-has?
- v. Service to limit and bound its use.

3) Any system or device incapable of controlling and/or disabling Who-has? Broadcast services it is capable of initiating will not be accepted.

c. Time synchronization

1) The Time-sync broadcast service must be configurable; only bounded time broadcasting is permitted. Directed Time-sync communications is preferred.

d. Broadcasting on IP Networks

1) General Broadcasting Guidelines:

- a) Broadcast services of any kind must not be used except where absolutely necessary.
- b) Where broadcast services are used, testing must be performed to ensure that the broadcasts and/or the responses do not cause system instability or loss of performance.
- c) Unbounded broadcast services are strictly prohibited. Any system that requires the use of unbounded broadcast services, or is unable to be configured to use bounded broadcast services, shall not be accepted.

- e. Multicasting
 - 1) Systems that require multicasting will not be accepted.
 - f. BBMDs
 - 1) Systems that require BBMDs will not be accepted. The use of BBMDs, where that functionality might be desirable, shall be regulated by Pima Community College. Any device capable of BBMD functionality must have that functionality disabled until Pima Community College expressly approves in writing the functionality for each specific device.
 - g. Foreign Devices
 - 1) BBMD-capable devices must also support foreign device registration.
4. BACnet Devices
- a. All BACnet devices shall be BTL-certified.
 - b. BACnet networks:
 - 1) The following controllers shall be BACnet/IP:
 - a) B-RTR
 - b) B-BC
 - c) B-AAC
 - d) B-AWS
 - e) B-OWS
 - f) B-GW
 - 2) BACnet MS/TP is permitted for the following controllers:
 - a) B-ASC
 - b) B-SS
 - c) B-SA
 - d) B-OD
 - 3) BACnet/Ethernet is not permitted, and this functionality must be disabled prior to connection to any Pima Community College network.
 - 4) ARCNET is not permitted, and this functionality must be disabled prior to connection to any Pima Community College network.
 - 5) LonWorks-protocol devices are in no way compatible with BACnet devices.
 - 6) LonWorks/LonTalk/LON is not permitted.
 - 7) Proprietary protocols are not permitted.
 - 8) Wireless protocols are not permitted except with express permission from
 - 9) Pima Community College. Where permitted:
 - a) WiFi 802.11

i. WPA2 encryption shall be supported and implemented

10) BACnet devices and networks must be configured optimally for high-performance and low response latency. Serial networks (MS/TP) must be sized to perform without latency issues, regardless of the traffic imposed on them to support control, monitoring, and trending functions.

5. Required BIBBs (see following tables):

a. Refer to the tables below:

ALARM AND EVENT MANAGEMENT											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
AE-ACK-B	Acknowledgement	•	•			•	•				•
AE-ACK-B	Acknowledgement					•	•				
AE-ASUM-A	Alarm Summary	•	•				•				•
AE-ASUM-B	Alarm Summary	•	•			•	•				
AE-ESUM-A	Enrollment Summary	•	•			•	•				
AE-ESUM-B	Enrollment Summary					•	•				
AE-INFO-A	Information	•	•			•	•				•
AE-INFO-B	Information					•	•				
AE-LS-A	Life Safety	•	•								
AE-LS-B	Life Safety										
AE-N-A	Alarm and Event Notification	•	•			•	•				
AE-N-E-B	Notification - External Device					•					
AE-N-I-B	Notification - Internal					•	•				
AE-VM-A	View and Modify Some Parameters	•	•								
AE-AVM-A	View and Modify All Parameters	•									
AE-VN-A	Notification - View Some Info	•	•								
AE-AVN-A	Notification - View All Info	•									
AE-ELVM-A	Event Log - View and Modify	•									

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DATA SHARING											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
DS-COV-A	Change of Value					•	•				
DS-COV-B	Change of Value					•	•				
DS-COVP-A	Change of Value - Property										
DS-COVP-B	Change of Value - Property										
DS-COVU-A	Unsolicited COV					•	•				
DS-COVU-B	Unsolicited COV					•	•				
DS-RP-A	Read Property	•	•			•	•				•
DS-RP-B	Read Property	•	•		•	•	•	•	•	•	
DS-RPC-A	Read Property Conditional										
DS-RPC-B	Read Property Conditional										
DS-RPM-A	Read Property Multiple	•				•	•				
DS-RPM-B	Read Property Multiple	•				•	•	•			
DS-WP-A	Write Property	•	•			•	•				•
DS-WP-B	Write Property		•		•	•	•	•	•		
DS-WPM-A	Write Property Multiple	•									
DS-WPM-B	Write Property Multiple					•	•				
DS-V-A	Read Commonly Used Properties	•									
DS-V-B	Read Commonly Used Properties										
DS-AV-A	Read Any Standard Property	•									
DS-AV-B	Read Any Standard Property										
DS-M-A	Modify Commonly Used Properties	•									
DS-M-B	Modify Commonly Used Properties										
DS-AM-A	Modify Any Standard Property	•									
DS-AM-B	Modify Any Standard Property										

DEVICE MANAGEMENT											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
DM-ADM-A	Discover All Objects in Any Device	•	•								
DM-ANM-A	Discover all Devices on the Network	•	•								
DM-BR-A	Backup and Restore	•									
DM-BR-B	Backup and Restore					•	•	•			
DM-DCC-A	Communication Control	•									
DM-DCC-B	Communication Control					•	•	•			
DM-DDB-A	Dynamic Device Binding	•	•			•	•				
DM-DDB-B	Dynamic Device Binding	•	•			•	•	•	•	•	
DM-DOB-A	Dynamic Object Binding					•	•				
DM-DOB-B	Dynamic Object Binding	•	•			•	•	•	•	•	
DM-LM-A	List Manipulation	•									
DM-LM-B	List Manipulation					•	•				
DM-OCD-A	Object Creation and Deletion	•									
DM-OCD-B	Object Creation and Deletion					•	•				
DM-PT-A	Private Transfer										
DM-PT-B	Private Transfer										
DM-R-A	Restart	•									
DM-R-B	Restart					•					
DM-RD-A	Reinitialize	•									
DM-RD-B	Reinitialize					•	•	•			
DM-RD-B	Reinitialize					•	•	•			
DM-TM-A	Text Message										
DM-TM-B	Text Message										
DM-TS-A	Time Synch - Local Time	•	•			•					
DM-TS-B	Time Synch - Local Time				•	•					
DM-UTC-A	Time Synch - UTC	•	•								
DM-UTC-B	Time Synch - UTC				•	•					
DM-VT-A	Virtual Terminal	•	•								
DM-VT-B	Virtual Terminal										

NETWORK MANAGEMENT											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
NM-CE-A	Connection Establishment			•							
NM-CE-B	Connection Establishment			•							
NM-RC-A	Router Configuration	•									
NM-RC-B	Router Configuration			•							

NETWORK SECURITY											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
NS-ED	Supports Encryption										
NS-KS	Key Server										

SCHEDULING											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
SCHED-A	Scheduling	•	•								
SCHED-B	Scheduling										
SCHED-VM-A	View and Modify	•	•								•
SCHED-VM-B	View and Modify										
SCHED-AVM-A	Create, View, and Modify	•	•								
SCHED-AVM-B	Create, View, and Modify										
SCHED-ELVM-A	View and Modify Event Log	•									
SCHED-ELVM-B	View and Modify Event Log										
SCHED-E-A	Scheduling - External	•									
SCHED-E-B	Scheduling - External					•	•				
SCHED-I-A	Scheduling - Internal	•									
SCHED-I-B	Scheduling - Internal					•	•				
SCHED-WS-A	Weekly Schedule										
SCHED-WS-B	Weekly Schedule										

TRENDING											
NAME	TITLE	B-AWS	B-OWS	B-RTR	B-GW	B-BC	B-AAC	B-ASC	B-SA	B-SS	B-OD
T-ATR-A	Automated Trend Retrieval	•									
T-ATR-B	Automated Trend Retrieval					•	•				
T-V-A	Display Trend Values	•	•								
T-V-B	Display Trend Values										
T-AVM-A	Modify All Trend Configuration	•									
T-AVM-B	Modify All Trend Configuration										
T-VMT-A	View and Modify Trends	•	•			•	•				
T-VMT-E-B	View and Modify					•					

	Trends External										
T-VMT-I-B	View and Modify Trends Internal					•	•				

6. BACnet Gateways (B-GW)

- a. Only BACnet devices are to be connected to the Pima Community College EMCS network.
- b. BACnet gateways shall not be used to connect new non-BACnet controllers or other devices unless specifically approved in writing by RFI to Pima Community College.
- c. Where possible/available, when BACnet gateways are used, they shall be configured to facilitate all available BACnet functionality. Devices connected using a gateway shall support the following BIBBs at minimum: DS-RP-B, DS-WP-B, DM-DDB-B, DM-DOB-B, DM-DCC-B, DM-RD-B. Objects made available using a gateway shall support the following BIBBs at minimum: DS-RP-B, DS-WP-B (DS-WP-B where "write" function applies).
- d. Any device or network connected to the BACnet internetwork via a BACnet gateway is considered part of the BACnet internetwork, and all requirements that apply to the BACnet internetwork extend to the devices and networks connected via BACnet gateways. High- performance communications and interoperability is required, and BACnet gateway solutions shall meet these requirements.

7. BACnet Parameters

- a. BACnet network configuration parameters must be configurable.
- b. BACnet network configuration parameters include:
 - 1) Device ID
 - 2) Network Number
 - 3) UDP port
 - 4) BBMD feature settings (disabled unless specifically permitted by College)
- c. BACnet network configuration parameters shall be obtained from Pima Community College
 - 1) BACnet parameters are managed by Pima Community College.
- d. Automatically-generated BACnet network configuration parameters must be configured to avoid duplication of object, device, or network instances. Automatically-generated BACnet parameters must be capable of being manually configured; devices that only support automatically-generated BACnet parameters are not permitted.

8. IT Network

- a. TCP/IP network configuration parameters will be obtained from Pima Community College:
 - 1) IP address
 - a) Pima Community College currently uses IPv4 addressing.
 - 2) Subnet mask
 - 3) Default gateway
 - 4) DNS
 - a) Pima Community College currently does not support DNS.

b. Ports

- 1) BACnet UDP port will be obtained from Pima Community College.
- 2) Other ports, when required for BAS operation (non-BACnet TCP or UDP ports), must be submitted for approval.

c. Physical infrastructure

- 1) All IP network cabling and cabling installation shall meet or exceed Pima Community College specifications and standards. Cabling shall be installed from EMCS devices to locations designated by Pima Community College as managed IP switch locations (data closets). All IP cabling shall be installed with adequate service loops in designated IP switch locations to facilitate connection to Pima Community College IP switches regardless of IT rack or switch installation configuration.
- 2) Separate networks for EMCS devices shall not be permitted; Pima Community College IT infrastructure shall be leveraged to support EMCS devices.
- 3) All end devices must connect directly to a Pima Community College managed IP switch; no unmanaged switches or hubs shall be permitted except for temporary service until the permanent IP network is functional. Temporary IP network equipment shall be removed and devices migrated to Pima Community College IP network when permanent IP network is ready.

9. BACnet Implementation

- a. During the execution phase of the project, coordination with the College is required to avoid or plan for potential system or network disruption. A risk and impact assessment must be performed prior to any activity that might disrupt existing system functionality. System outages must be planned three (3) weeks prior to work being performed.
- b. Activities that may impact existing system performance include (but are not limited to):
 - 1) Adding a new controller to the network
 - 2) Removing a controller from the network
 - 3) Re-addressing existing controllers
 - 4) Modifying existing programming
 - 5) Changing device BBMD settings
 - 6) Altering router tables
 - 7) Altering BBMD tables
 - 8) Altering foreign device settings
- c. Where possible when adding new devices, the new internetwork segment(s) shall be isolated and screened for proper configuration prior to being added to the existing internetwork.
- d. After new devices, networks, programming modifications, or configuration settings have been added to the existing network, network diagnostics must be performed and documented to ensure that the changes have not adversely affected the system. Any changes found to be having negative effects shall be reported to Pima Community College, and immediately reverted until such time that the issue can be resolved. Resolution of the issue shall be coordinated with Pima Community College to minimize the impacts to facility operations.
- e. BACnet Features:
 - 1) Required fields for BACnet devices:
 - a) Object Name

- i. Object Name shall be named according to the Object Naming Standard
- b) Location
 - i. Location field shall, at minimum, include room number where the device is located
- c) Description
 - i. Description field shall be used to identify the mechanical or other equipment served by the device
- d) Vendor Name
- e) Vendor Identifier
- f) Model Name
- g) Firmware Revision
- h) Application Software Revision

2) Required fields for BACnet objects:

- a) Object Name
 - i. Object Name shall be named according to the Object Naming Standard
- b) Object Type
- c) Description
 - i. Description field shall include text describing the object
- d) Device Type
 - ii. The Device Type field shall identify the type of sensor connected
- e) Units
 - iii. Engineering units shall be standard BACnet units

10. BACnet Commissioning & Acceptance

a. BACnet Parameter Commissioning

- 1) To ensure that all BACnet parameters have been configured correctly, each new device must be certified to have the parameters submitted and approved prior to project execution. Additionally, the BACnet internetwork must be free from errors; after all work has been completed, the vendor must submit a diagnostic report that reflects a properly functioning BACnet internetwork.
- 2) BACnet PICS must be submitted for each device model supplied as part of the project. All new devices must be BTL-certified.

11. BACnet Device & Network ID Standards

a. BACnet Device Object ID Parameters:

- 1) Description:
 - a) BACnet permits the interconnection of up to 4,194,303 devices.
 - b) Each device is referenced by its device Object_ID property.
 - c) Each device shall have a value for the Object_ID property that is unique across Pima Community College buildings, including existing devices.
 - d) No device shall have an Object_ID with an instance number less than 1000.
 - e) No device shall have an Object_ID with an instance number greater than 3,999,999.
 - f) Device Object_ID parameters shall be obtained from Pima Community College.

b. BACnet Network Number Parameters:

- 1) Description:

- a) The BACnet permits the interconnection of up to 65,535 networks.
- b) Each network must have a Network Number that is unique across Pima Community College buildings, including existing networks.
- c) No network shall have a Network Number less than 1000.
- d) Network Number 65,535 shall not be used.
- e) Network Number parameters shall be obtained from Pima Community College.

c. BACnet MS/TP MAC Addressing:

- 1) Master devices use token passing.
- 2) Slave devices reply to requests only. They do not support the Who-is? service, and therefore cannot be automatically discovered.
- 3) MS/TP (Master Slave/Token Passing) addressing consists of 256 (0-255) addresses:
 - a) 0 shall be reserved for the BACnet Router (B-RTR) serving the MS/TP segment.
 - b) 1-127 may be used for master or slave devices.
 - c) 128-254 are reserved for slave devices only.
 - d) 255 is reserved for broadcasting.
- 4) MAC addresses shall be obtained from Pima Community College.
- 5) MS/TP networks shall be limited to approximately 30 slave devices to prevent network latency.
- 6) MAC addresses on a network shall be consecutive starting with 0 (B-RTR). (Some products reserve addresses 0, 1, 2 & 3. In cases like this, the addresses must be as nearly consecutive as possible.)
- 7) The "Max Master" parameter for all applicable devices associated with an MS/TP network shall be set to the address of the highest-addressed master device.

C. Configuration and Programming Tools

1. Contractor shall provide all software (including any licensing required), hardware (special cables, operator terminals, etc.), and administrator access privileges to allow full configuration, programming, and administration of all system components and devices provided. Pima Community College has a limited ability to support different products and tools. Therefore, only certain products and tools shall be accepted. These include:
 - a. Delta Controls ORCAview OWS Software
 - 1) Requires hardware USB key
 - b. Schneider Electric
 - 1) iNet configuration software and cables
 - a) All software and/or firmware shall be of latest revision available (at substantial completion). The software shall be provided with a license that never expires.
2. Configuration and programming tools shall be provided for any EMCS product provided to Pima Community College as part of any project. Tools must enable trained controls technicians to:

- a. Automatically back up & restore controller configuration and programming database
 - b. Add/remove/edit control points from controller database
 - c. Add/remove/edit controller programming (control logic)
 - d. Add/remove/edit schedules, trends, alarms, etc.
 - e. Manage and configure devices
 - f. Configure device IP network configuration
 - g. Configure device BACnet network configuration
3. Server-based tool software:
 - a. Where applicable and preferred by Pima Community College, tools shall be installed on servers provided by Pima Community College.
 4. Workstation-based tool software:
 - a. Where applicable and preferred by Pima Community College, tools shall be installed on workstation computers provided by the College. In cases where tools are being installed on remote workstations, laptops, or notepad computers, appropriate cables, converters, etc. required to connect the tool computer to supported controllers shall be provided.
- IV. Execution
- A. Submittals:
 1. Submittals provided must meet requirements outlined in any/all contract or specification documents pertaining to the project, and for the evaluation of the technology systems proposed shall also include at minimum:
 - a. Device schedule in electronic spreadsheet format (use template available from Pima Community College, Tab B11 – Object Naming Standard including:
 - 1) Device name/description
 - 2) Manufacturer
 - 3) Model
 - 4) Device type (BACnet device type)
 - 5) Network type (B/IP or MS/TP)
 - 6) Software revision
 - 7) Firmware revision
 - 8) Location (room number)
 - 9) Controlled equipment

10) MS/TP network(s) supported (number of MS/TP networks supported)

11) Host controller (BACnet router for MS/TP devices)

12) Columns reserved for Pima Community College-assigned:

- a) IP Address
- b) Subnet mask
- c) Default gateway
- d) BACnet UDP
- e) BACnet Device ID
- f) BACnet Network Number
- g) BACnet BBMD authorization
- h) BACnet MS/TP Address (MAC address)

b. Device technical data, technical manuals, and IT security hardening guide

c. Device BACnet PICS for each BACnet-compliant device

d. Description of BACnet implementation, including diagrams and technical information regarding the specific requirements and limitations of the implementation

e. Floor plan drawings indicating the location of each device

f. Riser diagram(s)

g. Network topology diagram(s)

1) Include a schedule of BACnet Networks with a column reserved for Pima Community College-assigned BACnet Network Numbers.

h. Data flow diagram describing interoperability between proposed system(s) and other building systems, including integration, data collection, user interface, enterprise servers (with the understanding that the product may be hosted by enterprise server products from other vendors), etc.

i. Sequence of Operations (SOO) to be used in creation of control logic. (PCC approval is required prior to implementation.) All programming shall be uniform and consistent.

j. Request for information (RFI) requesting Pima Community College-supplied IT, BACnet, and other required parameters

k. Design engineer contact information for proposed system

l. Technical contact information for the proposed products

B. Technology Deployment

1. Devices shall not be added to the network until TCP/IP and BACnet parameters have been confirmed in coordination with the designated Pima Community College representative.

2. Any device causing or thought to be causing network disruption shall be removed from the network until such time that the contractor can determine the cause of the issue and provide resolution.

3. The contractor bears the responsibility of providing, configuring, and deploying network (IP and BACnet) devices in a manner conducive to a properly operating, error-free network.

C. Networking

1. Physical Networks

a. Cabling

- 1) Refer to Pima Community College guidelines for cabling specifications and installation guidelines (for 10/100/1000 and fiber-optic cabling). To avoid duplication of effort, all cabling shall be compliant with and installed according to Pima Community College standards. Coordinate with Pima Community College to identify locations of Pima Community College network switches (existing or future), risers, raceways, and cabling trays. Refer to Pima Community College design if available, and install cabling in a manner to avoid duplication of work where possible.
- 2) Provide adequate cabling service loops to allow Pima Community College to re-terminate cabling to patch panels.
- 3) Label cables according to Pima Community College standards. Provide labels that will stay securely affixed and legible throughout the construction process.
- 4) All work shall comply with codes and standards applicable to each type of work through the course of this contract.
- 5) Conduit or other appurtenances that are required by Pima Community College (regardless of codes or standards) shall be provided and installed by cabling installer. At minimum, cabling shall be installed in conduit in all mechanical and electrical rooms, and in unfinished warehouse or storage spaces. Exposed cabling in these areas is not permitted, regardless of the presence of existing exposed cabling.
- 6) Core-drilling and other cabling pathway-creating activities shall be included where necessary. All penetrations shall meet code requirements.

b. Network Hardware

- 1) All IT network hardware components shall be provided, installed, and configured by Pima Community College. Temporary IT network hardware shall be supplied by contractor as needed to maintain project schedule, and shall be removed when Pima Community College network is ready and in coordination with Pima Community College.
- 2) Enclosures intended for the installation of Pima Community College network hardware components may be installed by other contractors under the direction of Pima Community College or authorized representatives.
- 3) Absolutely no network routers, switching, wireless, or other hardware shall be connected to Pima Community College network without the express and specific permission of Pima Community College. Contractor may connect devices to a temporary network to meet project schedule and milestones.
- 4) Absolutely no cellular modems or other wireless access devices shall be connected to the EMCS or other building systems unless prior written permission is obtained from Pima Community College. Any cellular modems or other wireless access devices shall be removed from the

system prior to connecting the system to Pima Community College network. Cellular modems or other devices that would circumvent Pima Community College IT security shall be removed prior to connection to Pima Community College network.

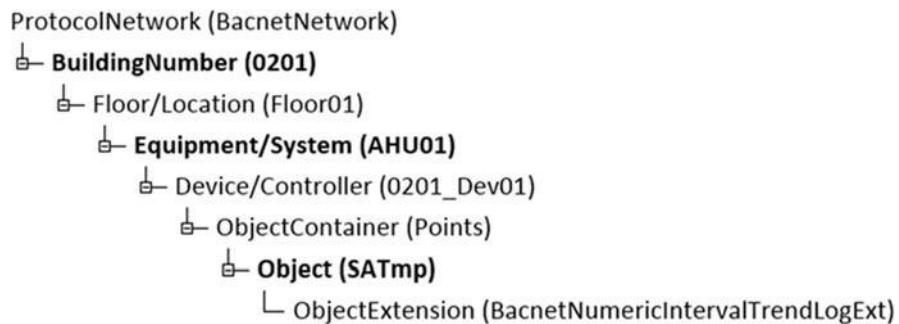
c. Device Hardening

- 1) Utilize a hardening guide and industry best practices when configuring any building technology device. All unused or unnecessary ports shall be disabled or closed, passwords shall meet or exceed complexity requirements, and network communication should be encrypted where possible. Policy techniques such as the principle of least privilege (POLP) and separation of duties (SoD) shall be implemented where possible. Default credentials for any device shall be disabled and replaced with user-specific administrative credentials for contractor technicians and Pima Community College technicians. Other less-privileged user accounts may be added also. Pima Community College system administrators shall be given access privileges greater than or equal to any other user account on the system prior to connection to Pima Community College network. The system administrator may immediately restrict vendor and other user access according to the principle of least privilege (POLP) for the remainder of the project. Refer to NIST SP800-123 for hardening guidelines.

D. BAS Object Naming Standard (Tab B11)

1. Pima Community BAS Object Naming Standard is intended to standardize the names of EMCS, Lighting, Metering, and other building control and monitoring objects. Systems must support at least thirty-character object names, and object names must never exceed thirty-five (35) characters.
2. The BAS Object Naming Standard shall be used to create all object and device names, without exception. The Standard is described in the BAS Object Naming Standard document available from Pima Community College. Objects include:
 - a. Device (controller, equipment, smart sensor - any device that has a BACnet Device ID)
 - b. Control points
 - c. Schedule objects
 - d. Calendar objects
 - e. Trend objects
 - f. Event Enrollment objects
 - g. Notification Class objects
 - h. Command objects
 - i. File objects
 - j. Graphic files
 - k. Reports
 - l. Any BACnet-discoverable object

- m. Any object mapped to the integration device/system
 - n. Any object created in the integration device/system
3. It is the contractor's responsibility to obtain the BAS Object Naming Standard document prior to implementation of any project.
 4. All object naming shall be submitted to Pima Community College for review and approval prior to implementation - any system objects implemented prior to Pima Community College approval shall be corrected by the vendor at no additional cost to Pima Community College.
 5. Any control object or point required by the controls application that is not represented in this standards document shall be submitted to Pima Community College via RFI. A response will be generated identifying the name that should be used for the application. If the supplied name is not currently represented in the standard document, it may be added by Pima Community College.
 6. It is understood that the object names for some products cannot be modified - so-called "canned-application" controllers. These object names shall be proposed with an indication that the controller cannot be customized. This information may be used in conjunction with other information as part of the vendor selection criteria.
 7. Refer to the BAS Object Naming Standard document for object naming guidelines. The specifications and instructions in that document are part of this general controls specification.



Trend Objects	Trend Interval
Temp Sensor	15-min
Air Volume	15-min
Damper Command	15-min
Damper Position	15-min
Valve Command	15-min
Valve Position	15-min
Fan Command	cov
Fan Status	cov
Compressor Command	cov
Compressor Status	cov
Compressor Modulation Command	15-min
Compressor Unloader Command	cov

Trend Objects	Trend Interval
Enthalpy/Heat Wheel Command	Cov
Enthalpy/Heat Wheel Status	cov
Humidity Sensor	15-min
CO2/VOC Sensor	15-min
Pressure Sensor	15-min
Temp Switch	cov
Pressure Switch	cov
Smoke Detector Switch	cov
Pump Command	cov
Pump Status	cov
Cooling Tower Fan Command	cov
Cooling Tower Fan Status	cov

Electric Heat Command	cov
Electric Heat Modulation Command	15-min
Mode	cov
VFD Speed Command	15-min
FD Speed Feedback	15-min
Inlet Vane Command	15-min
Inlet Vane Position	15-min

Effecting Temp Setpoint	cov
Effective Humidity Setpoint	cov
Effective Dewpoint Setpoint	cov
Effective Enthalpy Setpoint	cov
Effective Pressure Setpoint	cov
Effective Air Volume Setpoint	cov
Effective CO2/VOC Setpoint	cov

Boldface names shall conform to BAS Object Naming Standard guidelines and shall be used to comprise the names of Trend Objects using B-formatting as follows:

%parent.parent.parent.parent.parent.name%_%parent.parent.parent.name%_%parent.name%Td

The entire name shall not exceed 35 characters, as per the BAS Object Naming Standard.

8. Variations on the hierarchy shall be in keeping with the design intent; poorly organized hierarchy shall be rejected. Additional layers should be avoided.
9. BACnet Trend Objects shall be integrated from control devices for data upload and archival. Where the underlying system does not support BACnet Trend Objects, BACnet Trend Objects shall be created.
10. BACnet Schedule Objects shall be integrated from control devices. Where the underlying system does not support BACnet Schedule Objects, BACnet Schedule Objects shall be created.

E. Graphical User Interface (GUI) Standards

1. All graphical user interface (GUI) pages shall be created using standard templates provided to the contractor by the College upon request. Completed GUI pages shall include all of the types of information and features included in the templates, and shall not deviate from the template format. Page hierarchy, organization, and linking shall resemble existing examples.
2. Standard templates shall be requested for each individual project to ensure that the latest version of the templates are used for each project.

F. Technology Commissioning

1. In addition to any mechanical, electrical, or other building systems commissioning process included as part of the project, Technology Commissioning shall be performed to ensure that devices and systems have been deployed according to Pima Community College standards. This commissioning process covers:
 - a. IP network configuration
 - 1) The IP configuration of each IP device shall match Pima Community College-supplied settings.
 - b. BACnet network configuration
 - 1) The BACnet configuration of each device shall match Pima Community College-supplied settings.

- c. Product type application review
 - 1) Devices shall reside on the correct network type depending on the device type.
- d. Object Naming verification
 - 1) System objects shall be named according to the BAS Object Naming Standard.
- e. Integration organization review
 - 1) Integration of control devices and objects shall be logically organized, properly identified, and display functionality consistent with Pima Community College expectations.
- f. Documentation/literature review
 - 1) As-built documentation
 - 2) Product data sheets
 - 3) Product installation, operation, and maintenance manuals
 - 4) Product/system technical literature
 - 5) Configuration and programming guides/manuals
 - 6) Network security hardening guide
 - 7) Highest-level access credentials
 - 8) Complete configuration and programming backups for all devices
- G. As-Built Documentation
 - 1. The as-built shall contain, at minimum, all information included in the submittal, corrected to reflect the actual installation at the completion of the project.
 - a. The SOOs shall be included in the as-built and also provided in RTF format
- H. Warranty and Inspections
 - 1. Provide for complete service of controls system, including call backs, for 1-year running concurrent with warranty period. Make minimum of three (3) complete inspections of approximately 2-hours duration in addition to normal service calls to adjust controls with reports written and submitted to the Owner's representative during first year. Inspections shall be spaced 3-months apart. Requests for service during the warranty period must be responded to onsite within 24 hours of notification.
- I. Start-Up and Check Out
 - A. Provide start-up of system and program user supplied operating hours and holiday scheduling. A system demonstration procedure shall be developed, submitted to Owner's representative for approval, and performed in presence of Owner's representative for final check out of system. Major program modifications requested by the Owner shall be made at that time at no charge to the Owner.

- B. The control system shall be tested by the Contractor in the presence of the Owner's representative to demonstrate compliance with contract requirements. A complete simulation test shall be required. This shall be after the instruction sessions have been completed.
- C. System Acceptance: Satisfactory completion has been achieved when the contractor has performed successfully all the required testing to demonstrate performance compliance with the requirements of the contract documents to the satisfaction of the Pima CC's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

End of Section 23 09 23

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 21 00 - Hydronic Piping and Pumps

Introduction

Piping and specialties associated with heat transfer equipment including:

Chilled water, process cooling water, condenser water & heating water.

Part 1 - General

- Install a strainer with differential pressure transmitter to EMCS on building side of isolation valve for chilled water supply from tunnel system. Install a single pressure gauge across strainer (see Section 22 05 00 – Common Work Results for Plumbing requirements).
- Use reverse return piping concept and eliminate balancing devices for all banked coil applications.
- Use circuit-setting devices in closed loop systems. Preferred design is a variable flow pumping system controlling system differential pressure and using externally adjustable pressure dependent circuit setters at each point of use.
- Provide 3-way valves in heating water piping at end of branch line units only.
- Design heating water systems with a 40°F temperature differential. – (140°F- 180°F)
 - Refer to meter requirements (Section 40 71 00 – Flow Measurement).
- Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC for testing requirements.

Part 2 - Products

• **Pipe Schedule**

Size	Pipe	Fittings	Joints
Above Ground			
Up to 2"	Copper Type "L" Seamless Hard Drawn	Wrought Copper	Less than 0.2% Lead Alloy Solder
2 ½" and larger	Copper Type "L" Seamless Hard Drawn	Wrought Copper	15% Silver Brazed
	OR		
	Schedule 40 Black Steel	Forged Carbon Steel	Bevel Welded
Below Ground			
Up to 2"	Copper Type "K" Seamless Hard Drawn	Wrought Copper	6% Silver Solder
2 ½" and larger	Copper Type "K" Seamless Hard Drawn	Wrought Copper	15% Silver Brazed
	OR		
	Ductile Iron	Ductile Iron	Push-on or Mechanical

- Pipe Gasketing - Water Services - Garlock or PCC approved equal.

- Valve Types: Butterfly, Globe or Ball. No Gate Valves shall be used.
- Preferred manufacturers are Norris, Centerline or PCC approved equal.

- Thermometers
 - Adjustable angle type 9" die cast aluminum thermometer with separable well. Select with normal operating range at the midpoint of the scale. Install thermometer on both sides of each flow stream across coils, heat exchangers, etc.

- Pressure Gauges
 - Cast aluminum with 4 ½" dial. Select with normal operating range at the midpoint of the scale. Provide with pressure snubber and shutoff valve.
 - Provide gauges at each pump, AHU coil, and heat exchanger.
 - Use a single gauge oil-filled manifold with valving on each side of equipment.

- Expansion Tanks
 - Provide diaphragm-type compression tank with replaceable diaphragm.

- Air Vents
 - Provide automatic float and trap air vents in mechanical rooms only.

- Expansion Joints
 - Provide bellows type. Type 316 stainless steel.
 - PCC Amtrol only with bracket support.

- Pressure Regulators
 - Brass body, threaded connections.

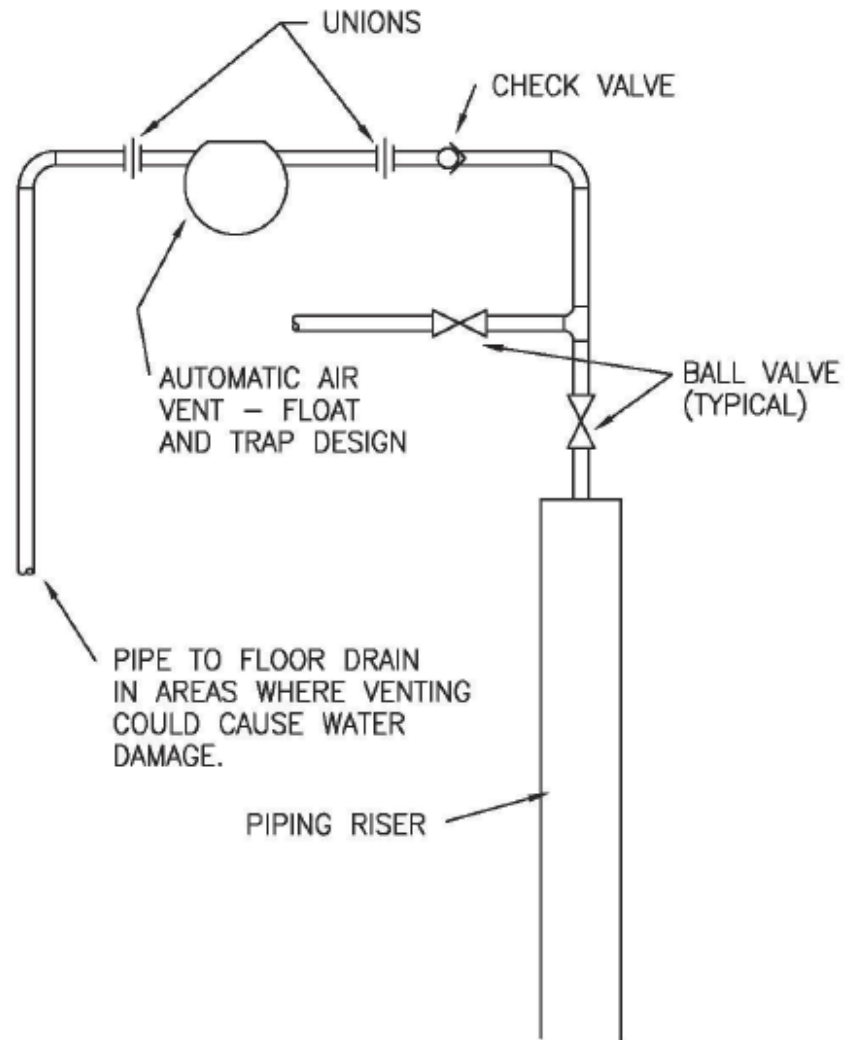
- Flow Regulating Devices
 - Circuit setter with external adjustment and indicator with threaded connections only.
 - Pressure independent flow balancing - restrict use to areas approved by the PCC.

- Hoses
 - High pressure, braided stainless steel and rated for temp and pressure requirements.

Part 3 - Execution

- Weld inspection: See Specification 22 05 00 – Common Work Results for Plumbing, Part 3 - Execution.
- Perform a minimum of three passes on weld joints (root, filler, and cap).
- Route piping to allow sufficient access to all equipment, valves, controls, etc., for maintenance.
- In general, piping shall be installed below electrical conduits not requiring maintenance access.

- Piping shall be secured at each trapeze hanger or support.
- Install piping sufficiently below structure to allow top air vents.
- Provide isolation valves on each side of strainers and full port ball valve on blow down. Provide hose thread connection on blow down port $\frac{3}{4}$ " and below.
- Provide air vent with isolation valve at all system high points. Install automatic air vents in equipment rooms and manual air vents elsewhere. Automatic air vents are to be piped to drain. Minimum vent piping size is $\frac{1}{2}$ ".
- Provide ball valves with hose end threads for system drains.
- When an existing system "hot tap" is necessary, provide a full port ball valve to isolate the new branch line.
- Do not use circuit setter as isolation valve.



HIGH POINT AUTOMATIC AIR VENT

NO SCALE

PIMA COMMUNITY COLLEGE MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL:	HIGH POINT AUTOMATIC AIR VENT
DETAIL NO.:	20 21 00-D 1

End of Section 23 21 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 23 00 - Refrigerant Piping

Introduction

Piping and specialties associated with:

Refrigerant Systems.

Part 1 - General

- Do not use pre-charged line sets (e.g. Aero Equip.)

Part 2 - Products

- Pipe Schedule

Service	Size	Pipe	Fittings	Joints
Above Ground				
Refrigerant Piping	All	Type "L" ACR	Wrought Copper or Cast Brass	15% Silver Solder Brazed
Below Ground				
Refrigerant Piping	All	Type "K" ACR	Wrought Copper or Cast Brass	15% Silver Solder Brazed

- Use long radius fittings only

Part 3 - Execution

- Workmanship
 - Install per ASHRAE standards
- Installation
 - Provide isolation valves between split system components.
 - Provide nitrogen purge during soldering.
 - PCC reserves the right to cut into any two fittings to confirm the use of nitrogen purge.
 - Support piping every 6 feet.
 - Provide line size trap every 25 feet of vertical lift.
 - Provide a liquid line filter drier in an accessible location.

End of Section 23 23 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 31 00 – HVAC, Ducts and Casings

Introduction

Ductwork Systems including:

Metal ductwork, flexible ductwork & exhaust ductwork.

Part 1 - General

- All exhaust ductwork within the building shall be under negative pressure. Exhaust ductwork connections to equipment shall allow for proper drainage flow. Fume hood exhaust ductwork can be manifolded only if multiple exhaust fans are used.
- Special applications of products other than those listed must be submitted to the College for consideration.
- Use wrapped supply ductwork, except in acoustically critical applications where liner may be used only after written permission is given by the College. Lined ducts shall not be used in medical areas, clean rooms, or all high velocity supply ductwork.
- Ductwork downstream of air handling units shall be constructed in accordance with 100% effective duct length as per ASHRAE and latest SMACNA standards.
- Chemical exhaust ductwork to conform with ANSI/AIHA standard 29.5 - 1992
- Ductwork to be constructed per latest SMACNA HVAC Duct Construction Standards.
- Exhaust system designs shall conform to AIHA Industrial Ventilation manual.

Part 2 - Products

- Galvanized Steel shall be ASTM A 527, G90 of lock forming quality.
 - Heating & cooling supply and return, non-chemical exhausts – minimum 24 gauge.
- Stainless Steel shall be ASTM A 240, type 316
 - Spiral or welded for fume hood applications. Fittings shall be continuously welded – liquid tight.
 - All welded seams for perchloric applications.
- Coated Galvanized Steel
 - Under special circumstances, with College permission, coated galvanized steel ducts may be used for manifolded general chemical exhaust plenums, which are large enough to allow duct internal inspection and repair of coating.
- Flexible Ductwork
 - All flexible ductwork applications to be “Thermafex M-KC” or approved equal.
 - Ductwork to be constructed in accordance with NFPA 90A, 90B, UL181 Class 1.

Part 3 - Execution

- High-pressure flexible ductwork shall not be used for changes in direction.
- Low-pressure flexible ductwork may only be used to accommodate a total of a 45° change in direction. Hard elbows shall be used at diffusers.
- Flexible ductwork shall be secured utilizing steel draw-band clamp.
- Maximum flexible ductwork lengths - 18" on high-pressure systems, 48" on low pressure systems.
- Use center radius of 1.5 times duct width (minimum) on tees, bends, elbows.
- Use Hardcast AFG-1402 Foil-Grip tape, Hardcast DT-Tape with FTA-20 adhesive, or water based paint-on duct sealant for indoor use, or RTA-50 adhesive for outdoor use, to seal all duct joints.
- Ductwork shall be stored in a clean location prior to installation. Openings shall be covered to prevent entry of dust, moisture and general construction dirt/debris. Plastic sheeting securely taped over open ends will be acceptable.
- Provide balancing dampers at all branch ducts.
- Use single thickness turning vanes only in ductwork up to 2" pressure class. Install per SMACNA.
- Do not use turning vanes in reducing elbows.
- Utilize 45° branch duct entries with main duct size reduction downstream for medium and high velocity systems.
- Utilize 45° branch duct entries or full conical taps for low pressure ductwork. No Bellmouth, Flanged or Notch Spin-In connections permitted except at terminal/diffuser take-offs.
- No extractors allowed.
- Design with 15° convergence and divergence preferred. Absolute maximum of 30° divergence or 45° convergence.
- Use Pittsburg construction on longitudinal seams. Button punch snaplock construction is not acceptable.

End of Section 23 31 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 33 00 – Air Duct Accessories

Introduction

Equipment associated with:

Air handling systems including terminal boxes.

Part 1 - General

- Terminal Box test submittal data shall be in accordance with ADC/ARI Standard 880.
- Terminal Box controllers to be compatible with Campus EMCS. (See Section 25 55 00 – Integrated Automation Control of HVAC)

Part 2 - Products

- All Terminal units to be electric/electronic type.
- Use only 'long' terminal boxes for any air volume control application requiring accuracy greater than +/- 25%.
- Minimum press drop across Terminal Box to be 0.1" wg with control damper fully open.
- Terminal Boxes shall have screwed access doors if serviceable items are enclosed.
- Terminal Box damper leakage shall not exceed 2% of nominal box rating at 4" static pressure.
- All Terminal Box controls shall be externally mounted.

Part 3 - Execution

- Install terminal boxes with minimum of 18" clearance access for service and maintenance.
- Fire dampers to be installed in accordance with manufacturers installation instructions.

End of Section 23 33 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 34 16 - Centrifugal HVAC Fans

Introduction

Fan systems including:

Supply, return and exhaust air systems.

Part 1 - General

- Do not use VFDs on forward curved fans.

Part 2 - Products

- Preferred manufacturers; Greenheck, Loren Cook, ILG, Trane.
- Short coupled multi-belted fans to utilize companion sheaves in lieu of variable pitched sheaves.
- Max RPM for exhaust fans not to exceed 1800.
- Fans to be tested in accordance with ANSI/ASHRAE STD 51 and ANSI/AMCA STD 210.
- Centrifugal fans handling more than 1,000 CFM shall have backward inclined blades.
- Fans shall be statically and dynamically balanced at the factory.
- Standard Products - use same manufacturer for multiple installations for the same type.
- Permanently lubricated bearings are not acceptable on 10HP or larger drives.
- Bearings shall be heavy-duty split pillow block, self-aligning ball bearings with seals and grease nipples, minimum service life of 200,000 hrs.
- Provide drain connection in bottom of exhaust fan housing - minimum size 3/4".
- Provide access doors on housing- minimum size 18" x 18".
- Provide weatherproof package for any fan located outdoors.
- Utility fans serving fume hoods shall have minimum velocity of 3000 fpm. at stack discharge. Minimum height of discharge stack to be 10'.

Part 3 - Execution

- No discussion.

End of Section 23 34 16

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 50 00 – Central Heating Equipment

Introduction

Equipment associated with:

HVAC heat transfer systems including water coils, plate and frame heat exchangers, cooling towers and air washers.

Pumping equipment including the following types: vertical in-line circulating pumps, base mounted pumps.

Part 1 - General

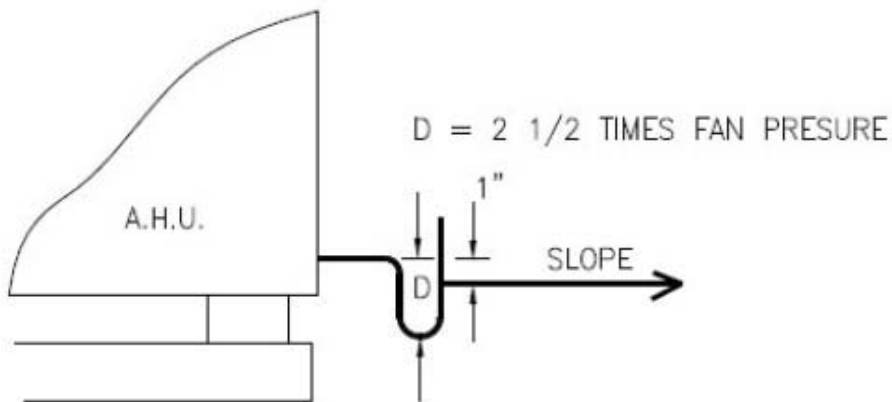
- Discuss heat exchanger type selection with PCC Planning & Construction. Plate frame heat exchangers are not to be used for steam/water applications.
- Design to account for water fouling factor in equipment selection.
- See water treatment section for related requirements.
- Coil Section
 - Select cooling towers at 76°F wb ambient.
 - Consider high dew point outside conditions when sizing cooling coils.
 - Select cooling coils with water temperatures of 44°F EWT/62°F LWT (summer) and 50°F EWT/62°F LWT (winter). Differential pressure: 15 ft. minimum, 50 ft. maximum.
 - Select heating coils with a 42°F water temperature differential.
 - Maximum coil face velocity 400 fpm.
 - Maximum coil air pressure drop 0.5" SP.
- Vertical in-line pumps are preferred with one pump as standby for building systems. Avoid base mounted pumps when possible.
- Use premium efficiency motors. See Section 22 05 00 – Common Work Results for Plumbing.
- Evaporative cooling in AHUs shall be accomplished by fixed cell Munters Fill Glasdek. Do not use water wheels.
- Adequate space and provisions shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.

Part 2 - Products

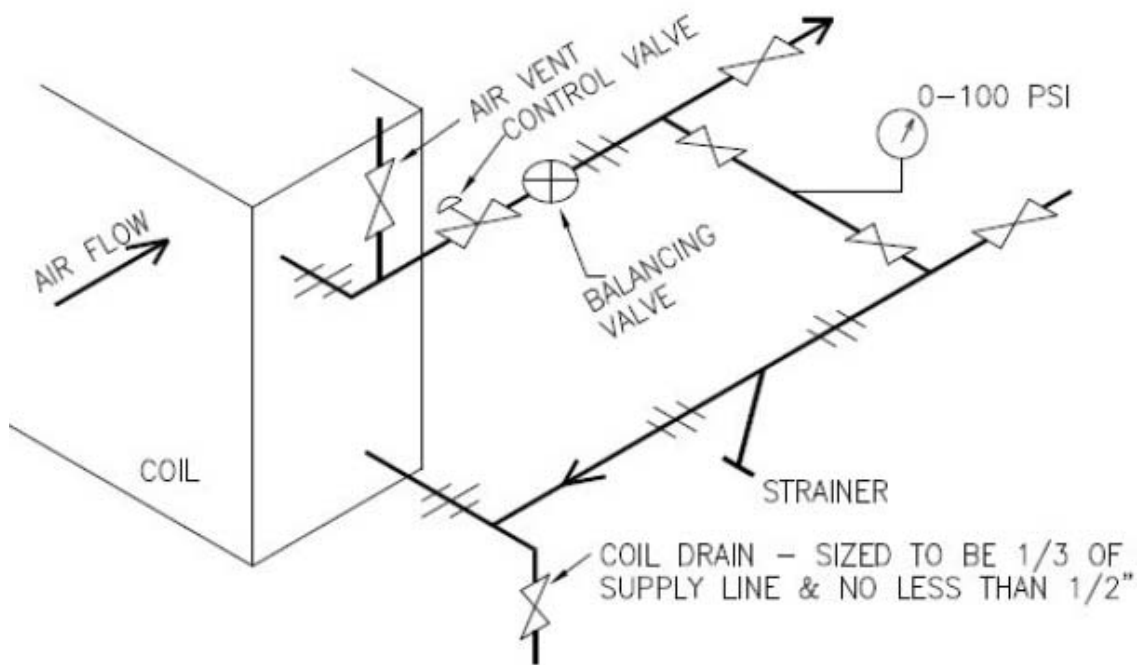
- Hydronic Coils:
 - To have bottom water supply and top return.
 - Use 5/8" minimum coil tube size.
- Vertical In-Line Pumps:
 - Preferred manufacturers; Grundfos, Bell & Gossett, Armstrong, Taco, Paco, Scott.

Part 3 - Execution

- Provide full port ball type isolation valves close to equipment.
- Provide single pressure gauge indication with pressure snubber for each system component.
- Provide thermometer temperature indication for each line of each component.
- Provide Weld-o-lets installed for future monitoring on each line.
- Provide system strainers on inlet water side(s) of all coils and plate and frame heat exchangers.
- Coils shall be piped with water counterflow to coils. See coil detail.
- Comply with manufacturer's recommended free air space for cooling towers.
- Provide manufacturer recommended clearances for maintainability.
- Provide coil and heat exchanger blowdown sized at 1/3 of pipe size but not less than 1/2" on all sides of heat exchangers with full port ball valve. (See attached diagram)
- Provide air vent on return pipe near high point with manual air vent (1/2" ball valve minimum) for all coils and heat exchangers.



TRAP DETAIL (Draw-thru unit)



COIL CONNECTION DETAIL

PIMA COMMUNITY COLLEGE	
MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL:	COIL CONNECTION & TRAP DETAIL
DETAIL NO:	15540-D1

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 52 00 – Heating Boilers

Introduction

Heat generation equipment including:

Boilers, furnaces, fuel fired heaters - Discuss all proposed installations with PCC Planning & Construction.

Part 1 - General

- The need for heat generation equipment must be approved by PCC.
- Boilers, furnaces and fuel-fired heaters shall be natural gas.
- Provide equipment schedule and piping schematics for installation of boilers, furnaces, and fuel-fired heaters.
- Provide access for service of equipment in accordance with code and manufacturer recommendations.
- Outside air reset shall be 80°F water when outside air is 80°F, to 140°F water when outside air is 30°F.

Part 2 - Products

- Boilers
 - Preferred manufacturers are Parker and Weil McLain.
 - Boiler shall be a packaged unit with a minimum efficiency of 85%.
 - Boilers shall come with low water cutoff (manual reset), dual aquastat high limit control with manual reset, remote aquastat, outside air reset, gas cock, gas pressure regulator, 100% flame safeguard with manual reset, control panel.
 - BACnet communication shall be provided integral to factory equipment controls.
- Furnace
 - Preferred manufacturers are Carrier, Rheem, and Trane.
 - Furnace shall be a packaged unit with an efficiency of more than 80%.
 - Furnace shall come with control relay for air conditioning.
 - Furnace shall come with high static pressure blower.
 - Heat exchangers shall have a minimum of 20-year warranty.
 - When available BACnet communication should be provided integral to factory controls.

Part 3 - Execution

- Provide temperature and pressure gauges, and expansion tank for boilers.

End of Section 23 52 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 60 00 – Central Cooling Equipment

Introduction

Equipment associated with:

HVAC heat transfer systems including water coils, plate and frame heat exchangers, cooling towers and air washers.

Pumping equipment including the following types: vertical in-line circulating pumps, base mounted pumps.

Part 1 - General

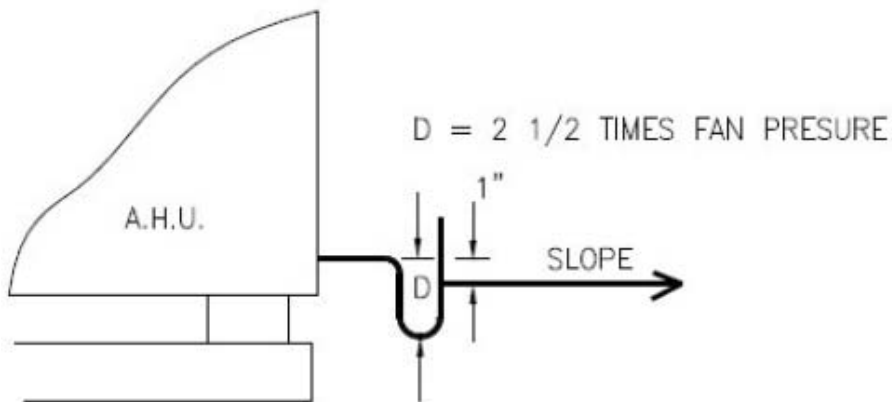
- Discuss heat exchanger type selection with PCC Planning & Construction. Plate frame heat exchangers are not to be used for steam/water applications.
- Design to account for water fouling factor in equipment selection.
- See water treatment section for related requirements.
- Coil Section
 - Select cooling towers at 76°F wb ambient.
 - Consider high dew point outside conditions when sizing cooling coils.
 - Select cooling coils with water temperatures of 44°F EWT/62°F LWT (summer) and 50°F EWT/62°F LWT (winter). Differential pressure: 15 ft. minimum, 50 ft. maximum.
 - Select heating coils with a 42°F water temperature differential.
 - Maximum coil face velocity 400 fpm.
 - Maximum coil air pressure drop 0.5" SP.
- Vertical in-line pumps are preferred with one pump as standby for building systems. Avoid base mounted pumps when possible.
- Use premium efficiency motors. See Section 22 05 00 – Common Work Results for Plumbing.
- Evaporative cooling in AHUs shall be accomplished by fixed cell Munters Fill Glasdek. Do not use water wheels.
- Adequate space and provisions shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.

Part 2 - Products

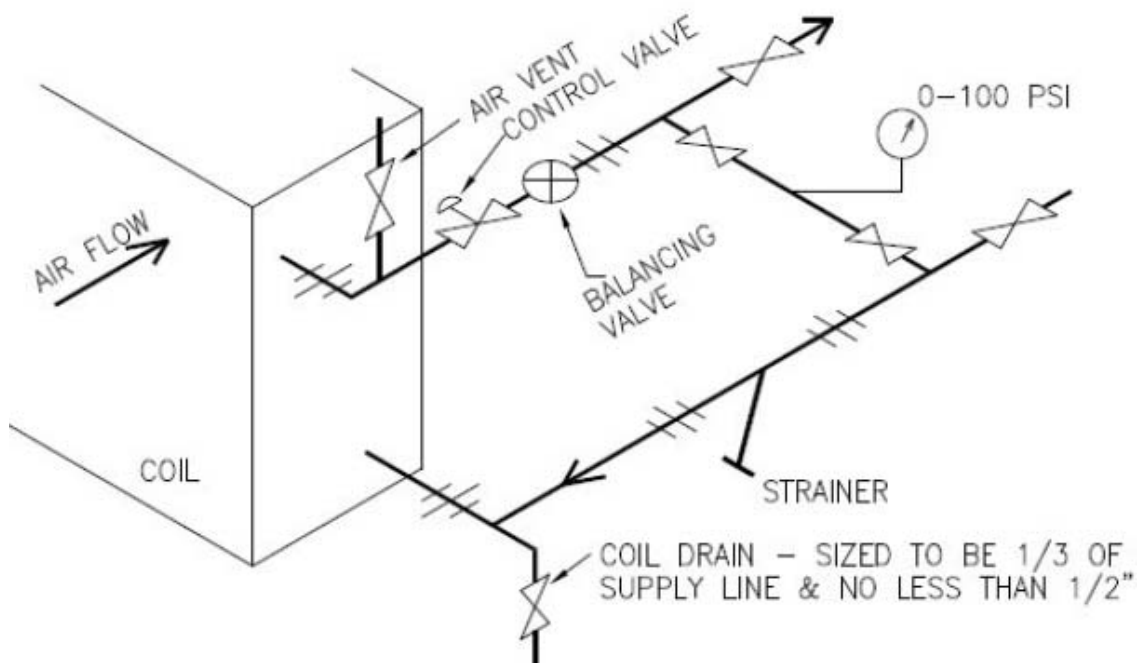
- Hydronic Coils:
 - To have bottom water supply and top return.
 - Use 5/8" minimum coil tube size.
- Vertical In-Line Pumps:
 - Preferred manufacturers; Grundfos, Bell & Gossett, Armstrong, Taco, Paco, Scott.

Part 3 - Execution

- Provide full port ball type isolation valves close to equipment.
- Provide single pressure gauge indication with pressure snubber for each system component.
- Provide thermometer temperature indication for each line of each component.
- Provide Weld-o-lets installed for future monitoring on each line.
- Provide system strainers on inlet water side(s) of all coils and plate and frame heat exchangers.
- Coils shall be piped with water counterflow to coils. See coil detail.
- Comply with manufacturer's recommended free air space for cooling towers.
- Provide manufacturer recommended clearances for maintainability.
- Provide coil and heat exchanger blowdown sized at 1/3 of pipe size but not less than 1/2" on all sides of heat exchangers with full port ball valve. (See attached diagram)
- Provide air vent on return pipe near high point with manual air vent (1/2" ball valve minimum) for all coils and heat exchangers.



TRAP DETAIL (Draw-thru unit)



COIL CONNECTION DETAIL

PIMA COMMUNITY COLLEGE	
MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL:	COIL CONNECTION & TRAP DETAIL
DETAIL NO:	15540-D1

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 62 13 - Packaged Air-Cooled Refrigerant Compressor and Condenser Units

Introduction

Equipment associated with air conditioning systems including:

Packaged rooftop air conditions, split system air conditioners, single package heat pump and gas/electric air conditioners.

Part 1 - General

- All equipment shall comply with ASHRAE 90.1
- Packaged units shall be 100% factory run tested and fully charged.
- Cooling capacity ratings shall be based upon ARI and DOE test requirements.
- Size condensers for 115°F ambient temperature.
- Size evaporators for 80°F db/67°F wb indoor conditions unless project requirements are different.
- Provide filters with a MERV 8 or higher.

Part 2 - Products

- Heat Pumps
 - Provide minimum of 5kW strip heat for defrost mode where applicable.
- Roof Top Units
 - Provide filters in return ductwork or return grilles.
 - Maximum filter face velocity shall not exceed 400 fpm.
- Fans and Motors
 - Where available, specify belt driven fans with adjustable motor sheaves.
- Gas Fired Heating Sections
 - Minimum of 20-year warranty.

Part 3 - Execution

- Install per manufacturer stated clearances.
- Condenser clearances to obstructions to be a minimum of 2 feet or as per manufacturer recommendations.
- Provide 3 feet clearance around rooftop units or remote condensing units.

- Provide maintenance access to all equipment requiring service.

Part 4 – Controls

- BACnet communication shall be provided integral to factory equipment controls.

End of Section 23 62 13

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 64 00 - Packaged Water Chillers

Introduction

Air and water-cooled chillers up to 100 tons – Discuss all proposed installations with PCC Planning & Construction.

Part 1 - General

- Equipment room - design room within existing codes, EPA regulations and ASHRAE design standards, in particular ASHRAE 15 including the separation of refrigerant and combustion equipment and provision of alarms.

Part 2 - Products

- Acceptable manufacturers: Trane, Carrier, York, McQuay.
- Unit Description
 - Liquid chillers can be semi hermetic or scroll compression design. Separate refrigerant circuits shall include the following: liquid line solenoid valve, filter dryer, sight glass, thermostatic expansion valve and service valves.
 - Unit efficiency shall meet ASHRAE 90.1
- Evaporator
 - Shell and tube design manufactured in accordance with ASME standard, fully insulated and equipped with a drain connection.
- Condensers
 - Copper tube aluminum fin pressure tested to ASHRAE standards. Provide head pressure control.
- Electrical
 - All electric installations shall comply with the latest NEC standard. Include motor starters with equipment.
- Controls
 - All equipment shall be complete with leaving water control and unloading capability, low/high pressure switches, low ambient, freeze stat, flow switch and motor overload safeties, low oil pressure safety switches.
 - All AC units, RTV's and heat pumps must have BACnet capability on delivery. Factory BACnet boards are preferred.
 - BACnet communication shall be provided integral to factory equipment controls.
- Receivers
 - Shall be capable of entire refrigerant charge pumpdown.

- Head Pressure / Load Control
 - Shall be capable of running in low load and low ambient conditions. Provide compressor cylinder unloading where applicable.
- Refrigerant
 - Use HFC refrigerants. Do not use CFC or HCFC.

Part 3 - Execution

- Remote Interface - provide interface with building/campus energy management system for alarms, start/stop, status, water temperatures.
- All systems are to be dehydrated, leak tested charged and tested for proper control and operation.

End of Section 23 64 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 73 00 - Indoor Central-Station Air-Handling Units

Introduction

Equipment associated with:

Central station air conditioning & distribution.

See related Sections:

23 34 16 Centrifugal HVAC Fans
23 50 00 Central Heating Equipment
23 60 00 Central Cooling Equipment

Part 1 – General

- Discuss all system selections with PCC Planning, Design & Construction.
- AHU to be 'draw-thru' type.
- Preferred location of OA intakes is above roof level - not ground level. However, avoid location of AHU outside air intake in vicinity of plumbing vent stacks, emergency generator stacks and loading dock areas.
- OA intakes to be hard ducted through Mechanical Rooms unless a separate AHU room is provided.
- Equipment layout shall minimize / eliminate any system effect on fan static pressure.

Part 2 - Products

- Provide hinged access doors to both sides of coils, fans, filters and damper sections.
- Provide removable side panels in fan sections to allow for fan and shaft removal/replacement.
- AHU shall not be constructed using porous or semi porous materials.
- AHU shall be double walled casing - minimum 18 gauge.
- AHU shall have interior inspection lights.
- Large AHU to have inspection windows in access doors.
- Utilize only 'premium efficiency' motors in AHU's. See Section 22 05 00 – Common Work Results for Plumbing.
- AHU should be designed to minimize the number of field connections between sections.

Part 3 - Execution

- Ensure coil drain pans and condensate pipework is pitched to drain, (minimum pitch ¼" per foot).
- In new construction, utilize AHU to 'flush' building to reduce off gassing of interior furnishings prior to occupancy. Fit AHU with temporary filters during this period.

- Replace filters before system balancing.
- Provide vibration safety switches on all Vane Axial type fans.
- Provide suitable access for servicing/removal of fan assemblies.
- Control valves shall be located outside of air handler enclosure. (i.e. not within the airstream)
- Ensure access is provided to both sides of AHU fans to allow bearing replacement.
- Factory leak tests and sound tests are required.

End of Section 23 73 00

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Section 23 84 00 – Humidity Control Equipment

Introduction

Equipment associated with air conditioning equipment.

Part 1 - General

- Provide only when absolutely necessary or when a special Project requirement.
- Discuss with PCC Planning & Construction before specifying.

End of Section 23 84 00

Division 25 – INTEGRATED AUTOMATION

Section 25 55 00 - Integrated Automation Control of HVAC

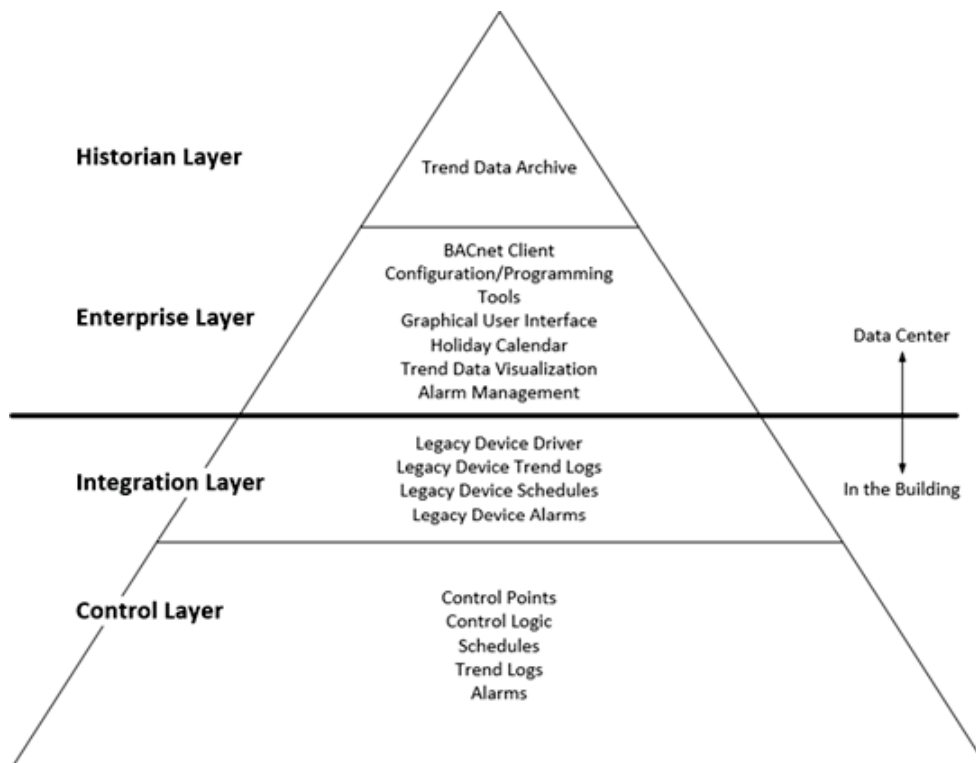
Introduction

Equipment associated with:

The management of heating, ventilation and air conditioning related utilities.

Part 1 – General

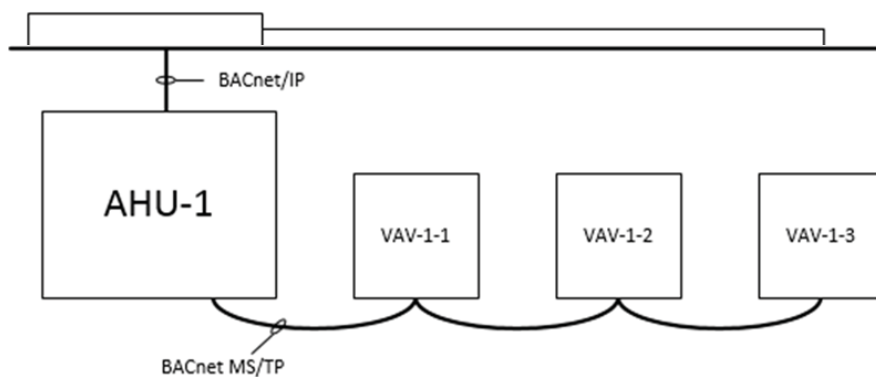
- Pima Community College requires EMCS providers to design, build, configure, and implement technology using a specified architecture that meshes with Pima Community College processes and procedures, allowing for interoperability, scalability, and high performance. This document is intended to assist the EMCS provider in understanding Pima Community College Standards and Specifications in a brief, illustrated overview
- Overall Architecture
 - The EMCS architecture is broken up into layers:
 - Control Layer: comprised of devices that host all I/O and all control logic required to control equipment; this layer also includes protocol routers.
 - Integration Layer: comprised of gateways employing drivers to integrate legacy systems.
 - Enterprise Layer: comprised of data-center-based server software hosting GUI and EMCS maintenance tools.
 - Historian Layer: comprised of consolidated data.



- BACnet
 - All new devices on the Control Layer shall be native-BACnet. This is intended to provide full interoperability on the Control Layer without the need for integration gateways or drivers. The EMCS provider is responsible for delivering and deploying BACnet devices that successfully join the BACnet internetwork without errors or communications issues. Pima Community College manages IP and BACnet network configuration parameters:
 - IP address, subnet mask, default gateway
 - UDP port
 - BACnet Network Number
 - BACnet Device ID
 - BACnet MS/TP MAC address
 - BBMD functionality

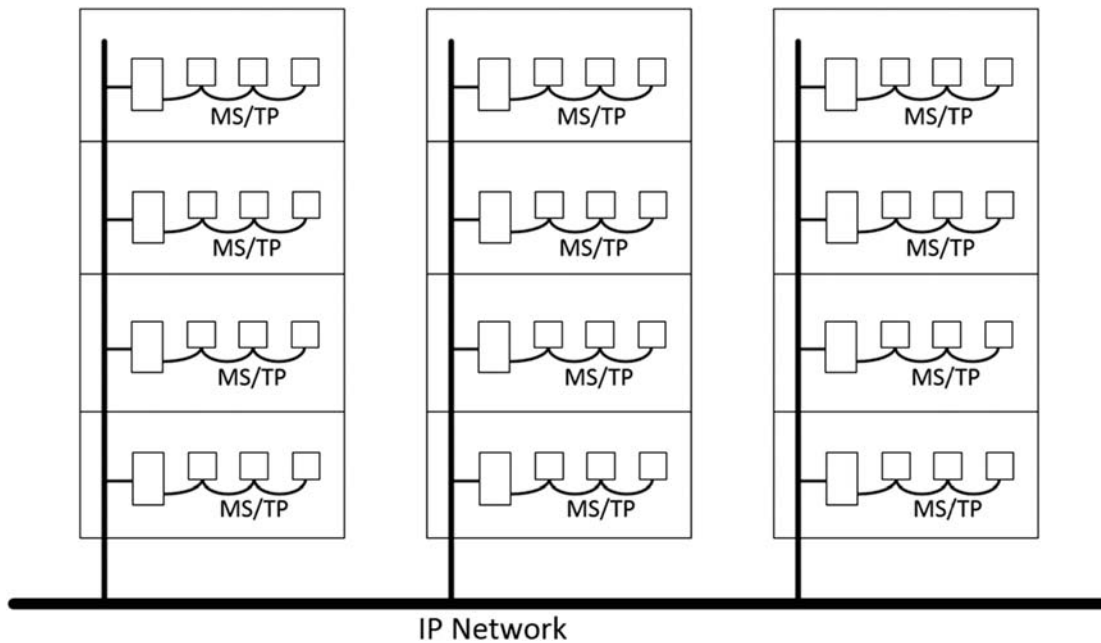
These parameters are managed by Pima Community College, and shall not be assigned ad hoc.

- Network Architecture
 - The network architecture model is BACnet/IP-based for major equipment controllers, and BACnet MS/TP-based for small equipment.
- Major equipment refers to central plant equipment, multi-zone AHUs and AHUs serving terminal units, central lighting panels, etc.
- Small equipment refers to FCU, VAV, CV, FTU, VRV, VV terminal units, single-zone AHUs, single-zone RTUs, VFDs, chillers, boilers, room or area lighting controllers, etc.
- If you are not sure if a device should be BACnet/IP or BACnet MS/TP, check with Pima Community College.
- The network strategy allows for approximately 30 devices per MS/TP network. It is preferred that MS/TP networks do not run between floors. Ideally, the MS/TP network should be modeled after the equipment arrangement.



Matching Network Arrangement

- BACnet/IP devices shall be connected to the existing Pima Community College IP network, and not on an ad hoc network. BACnet/IP routers shall be located on each floor or area allowing any MS/TP devices on that floor or area to be connected. The BACnet/IP router may be a major equipment controller, such as an AHU controller. The overall network riser should resemble the figure below:



Part 2 - Products

- Any device proposed or submitted for use on Pima Community College property shall be reviewed by Pima Community College. The EMCS provider must provide adequate information to assess the device in terms of functionality, security, applicability, and ultimate suitability for use in Pima Community College buildings/facilities. One important document is the BACnet PICS. No BACnet device will be permitted without a PICS. The other important item is BTL Certification. Pima Community College devices that are BTL-certified, and requires it in the specification. However, exceptions of BTL-certification can be made at the discretion of the reviewing Pima Community College technical engineer.
- All devices shall be BACnet, including any I/O or remote I/O expansion devices

Part 3 - Execution

- See specifications in Section 23 09 23 – Direct-Digital Control System for HVAC for more detail

End of Section 25 55 00

DIVISION 26 - ELECTRICAL

Section 26 00 00 - General Discussion

Introduction

Consultant shall incorporate the material in the manual into the project specifications. Refer any questions, clarifications regarding Division 26 to PCC Planning Design & Construction.

The electrical system is very important to the operation of many of the aspects of the operations of Pima Community College. Many of the buildings have testing, which need to go on continuously, and if the electrical power goes out during the testing then millions of dollars of work and equipment can be destroyed. For this purpose, it is very important to supply the most reliable electrical equipment system that can be designed. It is for this reason that many of the systems and specifications enclosed herein exceed the requirements of the National Electrical Code. In addition, it must be understood that:

The National Electrical Code is a minimum standard of the quality of work that can be used and shall not be used as a maximum for the quality of the electrical system.

The manual is a standard each Consultant, Builder and Project Manager needs to study as a standard for ALL Pima Community College renovations and new work.

The local lighting ordinances are exceeded.

Pima Community College is itself a small utility which maintains all of the secondary power distribution to all of the buildings on its' campus at both 13.8KV and 4.16KV. The standards specified herein reflect the requirements of this "utility". Note that at some other locations interface with standard utility requirements will be required. In those cases only will these standards be overruled. Attention to fault current and how it affects systems must be observed. The system energy capacity increases on an ongoing basis, as the result of ongoing campus utility modifications.

MINIMUM REQUIREMENTS

All electrical, mechanical, server and telephone rooms shall have smoke/heat detection. If, for any reason, electrical and mechanical rooms are equipped with liquid fire sprinklers, electrical equipment shall be NEMA 1 with sprinkler shields.

ELECTRICAL SWITCHBOARD ROOMS

Whenever the design for a new building or major expansion of an existing building is to take place special consideration shall be made for providing an electrical distribution switchboard room, which is sized adequately to house all of the major electrical switchboard items, which would need to be installed on the project. This shall include the primary distribution switchboard (usually 480 volt), the Fire alarm panel, some of the secondary transformers and 120/208 volt distribution panelboards, the automatic transfer switch, the generator status panel, and the motor control center (where required). This room shall have built in at least 40% spare capacity to allow for installation of future equipment as necessary and storage of pertinent electrical maintenance items. There shall be a minimum of two exits from the room with at least a 6' aisle between rows of electrical equipment or between electrical equipment and the wall. In addition, a separate area shall be made to house the primary distribution transformer, the standby / emergency generator, and any primary distribution switchgear required (such as a PMH switch). This area shall be located in an equipment yard just outside of the main building walls.

SERVICES

Existing Services

Existing electrical services will require specific attention with respect to replacement and expansion. Projects where the existing service equipment is not to be replaced, need to be evaluated for fault current, overload, deterioration, and grounding and safety violations. Where consultants design this work, reports will be required at the Schematic Phase and addressed with Pima Facilities Operations.

New Services

A Registered Professional Engineer shall design all new services.

Services, 1200 Amperes and Below

Services, 1200 amperes and below shall utilize stationary mounted power circuit breaker main breaker. Feeder breakers shall be electric, LSI, with communications capability.

Services Over 1200 Amperes

Services over 1200 amperes shall utilize draw out power circuit breakers.

All services shall

- Provide 13.8kv primary protection using a vacuum circuit breaker, 50/51 relay and snubber.
- Provide, 50/51 relays on the bus between the transformer and the main breaker
- Provide zone selective interlock between the 13.8kv- 50/51 relays, secondary relays and feeder breakers
- Provide arc flash calculations and PPE labeling for all electrical equipment, including panelboards.
- All main breakers shall be 100% rated.
- Shall be NEMA 3R Gasketed Construction outdoors.

SINGLE LINE DIAGRAM MINIMUM REQUIREMENTS

Single line diagrams shall be complete representations of the designed electrical systems. The goal is to allow the bidding and constructing contractor to bid the job using the correct equipment. The reviewer will require clear indications that all electrical parameters have been considered. Bidding and review shall not require tedious deciphering of keynotes. Nor shall the reader be burdened in flipping feverishly from sheet to sheet.

Single line representations shall include, but not be limited to; display of voltage levels, wye and delta configurations, bus sizing, sizes and types of main and feeder overcurrent devices, vertical bus sizes, horizontal bus sizes, pull sections, metering sections, grounding, spare bussing, bus extension provisions, transformer sizes, main breaker or lug locations for panelboards and switchboards, (bottom, top or feed through) fault levels, overcurrent device frame sizes and trip ratings, TVSS connections, TVSS overcurrent protection, feeder sizes, transformer sizes and housekeeping pads, primary cable conductor sizes and any other information necessary to provide a complete representation of the system.

The use of keynotes shall be minimized in the labeling of equipment and system components.

Switches, pull stations and automatic door closers in areas where the construction requires glass walls, glass doors and similar construction, shall require the architect to design mullions to accommodate orderly installation. Consultant shall coordinate these devices with the architect.

LIGHTNING PROTECTION

Lightning protection shall meet and exceed the requirements of NFPA 780 and the NEC.

Protection shall be provided where NFPA 780 calculation shows MODERATE conditions OR whenever directed by Pima Facilities Design & Construction.

If available, UL MASTER LABELING shall be included.

Design shall be performed by the electrical registrant for the project, put on plan and sealed. It shall not be done as a requirement specification. The Consultant may feel free to seek the expertise of Lightning Protection Companies in preparing their (the Consultant's) design.

Attention shall be given to the Suppression Requirements of NEC for data, power and phone. Attention needs to be given to the material types and quality of lightning specific components and how they are fastened to the building. Mastics shall not be the primary method of attachment. Components shall be copper or bronze. Wire shall be copper. Down conductors shall be the braided UL approved copper product specifically designed for the application. Ground plates are allowed for existing buildings where grounding by other methods is not practical.

Examine the job site prior to completing your fee. Contact CCIT for suppression needs and methods. Determine such things as RF antenna on roofs, walls or parapets, "Add on" suppression for power shall be either APT OR CURRENT SYSTEMS products, not less than 180 ka per phase.

All firms shall provide graphic presentation of the system isometrically.

Consultants shall evaluate the need for lightning protection on all new buildings and building additions. Utilize the assessment criteria in NFPA 780. Risk factors in the highly moderate to severe category shall require lightning protection.

Cranes over 75 ft. high shall be bonded to ground with #115,000cirmil copper cable to the foundation UFER ground. Use the same cable for the UFER ground.

Consultants are urged to consider use of Early Streamer Emission Air Terminal Systems vs. the conventional Franklyn System.

COORDINATION OF PROTECTIVE DEVICES AND STUDIES

Registered electrical engineers skilled in this area of expertise shall perform coordination studies, protective relay studies and adjustments.

The consultant shall submit selectivity curves in the design document and final construction documents show clean coordination of the devices aforementioned.

The consultant shall write the specifications to reflect the following:

Contractor shall submit equipment based upon the basis of design or one of the approved equals. The contractor shall provide with the submittal, a coordination study based on the equipment submitted. The contractor shall be required to submit equipment equal in characteristics to the basis of design. That is to say, the selectivity of the overcurrent devices shall be as clean in coordination as the basis of design devices. The consultant shall clearly display this requirement on the DRAWINGS where the switchboards and service equipment is identified.

Should the contractor submit a study, including related equipment submittal, that does not give clean coordination; the contractor shall be obligated to change components to allow clean coordination and selectivity, prior to getting approval for releasing equipment for manufacture at no cost to the Owner.

The contractor may utilize factory trained coordination engineers to prepare the study. However, curves must be plotted on standard log-log paper, 11" x 17".

References to Clean Coordination and selectivity shall be as defined in IEEE STD 192, as interpreted by Pima Community College Facilities Operations.

Coordination shall reflect all intentions of system planning per IEEE Std. 192.

- Selectivity curves shall be labeled with plain English nomenclature that identifies the devices on the project single line diagram, not some dapper reference file name. Each curve set shall have an I-line on the same page.

Consultants shall provide fault current levels for all new equipment required to have ARC FAULT labeling as required in NFPA 70E. ARC Fault calculations and equipment labeling shall be identified to be a requirement for the electrical contractor to have performed.

TEMPORARY STANDBY POWER

Temporary standby power used to power existing critical (research not life safety) building loads shall require the presence of a Pima College electrician for the duration of the outage.

New buildings equipped with standby engine generators shall be equipped with a “legally required” standby power transfer switch and distribution panelboard. Connect all telephone, communications and server room systems to this distribution panelboard. Similarly, provide a transfer switch and distribution panelboard for optional standby loads (NEC Art 702). Connect Blue Light Phones to available standby power.

Elevator Rooms

Consultant shall coordinate the size of elevator equipment rooms such that they have 20% space clear wall space or 48”, whichever is larger, upon completion of construction. All new construction drawings shall have riser diagrams, to scale, for each wall of the elevator machine room.

Part 1 – General

- These electrical standards represent the minimum quality of workmanship and the minimum quality of equipment, which are required for the projects, which are to be constructed on this site. The general attitude about equipment and materials to be supplied, is that the College will be here for many years to come and the projects which we construct now shall be able to be in service for 10, 15, 20, or more years without needing to be renovated due to the lack of quality of the electrical equipment or workmanship. In addition renovations will need to be made in the future to many of the areas which are under design today and for that reason spare capacity is to be built into the design to allow for a certain amount of flexibility for the future. Where the design engineer has some areas where he prefers to see an even higher level of quality than what is set by these standards he shall make the design to meet that level of quality as long as that design provides a cost effective design. Sometimes even though the design costs are considerably higher, the actual costs including maintenance over the life of the product make it cost effective.
- Working In Confined Spaces
 - Whenever work is required within a confined space, e.g., utility vaults, utility tunnels, sumps, pits, sewers, etc., contact Pima College Environmental Health & Safety Department for details and procedures on Pima College Confined Space Entry Program.
- As-Builts
 - As-Builts shall be prepared by the Contractor and professionally hand drafted in a clear legible manner. The Consultant will then draft these As-built annotations on the reproducible Record Drawing. See Tab B-9.
- Details

- Consultant shall provide GRAPHIC SCALES AND PROJECT NUMBERS ON ALL SHEETS.
- Miscellaneous
 - When panelboards are replaced, replace respective feeders and feeder breakers.
 - Designers shall coordinate motor service factors and efficiencies with mechanical trades and mechanical designers and bring this to the attention of the contractors.
 - The consultant shall make it clear to the contractor that deviations in design of major equipment shall not be a liberty that will be accepted. All equipment specified and supplied shall have been in the market place for a minimum of 2 years prior to bid date.

Part 2 - Products

- Specify the highest quality, best made type of equipment, which is manufactured today. Balance this with maintaining quality while conserving cost. If there are materials, which you know from working with, those in the past, which will not meet the requirements of this area of the specifications, then word your specifications to delete those items from being considered for use. Any types of material which by their very nature need to be looked at for meeting the quality that will be specified, needs to be specified to be submitted upon prior to installation for review by both the Design Engineer and the Facilities Engineer at Pima Community College. Single sourcing of a certain type of material shall be made only when other materials would not meet either the standard of the College or the required operation of the system for which it is specified. In most cases, single sourcing will not be permitted. The use of one or two manufacturers, which supply equipment which is known to meet the standards which are required for the particular operation, which is specified, shall be utilized. Other manufacturers, which may not be known at the time of design or who in the past, have manufactured equipment which is not the same quality as that which is specified then will have the ability to submit their equipment in accordance with substitution procedures
- Single sourcing already has been officially justified for fire alarm equipment, intrusion detection equipment, telephone/data hardware, primary cable, primary pad mounted switches and variable frequency drives. Prior approval is required for engine generators, transfer switches and primary cable deviations. There is no or equal to be considered after bidding where prior approval is required.

Part 3 - Execution

- It is the intent of the College to have all new work installed in a quality manner and in a way that it is accessible for future maintenance and expansion. The installation shall comply with both the requirements of OSHA, ADA Guidelines, NFPA, NESC and the NEC. In complying with OSHA regulations we wish to comply especially with the requirements of the lockout/ tag out regulations, and provide the personnel who have to work on the mechanical equipment serviced by the new electrical system with a completely maintainable system based on those regulations. As far as the quality of workmanship, we would like to have the electrical system installed in such a way that it both is functional, and looks like it has been installed in a professional manner.
- Contractors shall be required to label all equipment with ARC FAULT labels as outlined and required in NFPA 70E.

End of Section 26 00 00

DIVISION 26 - ELECTRICAL

Section 26 01 26 - Maintenance Testing of Electrical Systems

Introduction

Testing for all areas shall be listed under this section and referenced back to the appropriate section.

Testing shall be done in accordance with NETA standards.

Part 1 - General

- Written documentation shall be provided to the Pima Facilities Operations for all testing accomplished under this section.
- Although NETA test standards are referenced herein for brevity it is required that the engineering firm, rewrite the test standards for application to the specific project.
- All the required testing shall be fully spelled out in the specifications.
- Cable shall be tested on their respective reels.
- Cable shall be VLF tested with terminations in place after assembly.

Part 2 - Products

- A partial list of equipment to be tested shall include:
 - Feeders and cables
 - high voltage switchgear
 - transformers
 - panelboards
 - switchboards
 - emergency generator
 - ups type systems.
 - 50 hp and larger motors - absorption - polarization index
- Testing of medium voltage cables (5KV or 15KV), transformers, and switchgear shall be by a third party testing firm which has all of the equipment and capabilities for performing the specified tests.
- The electrical contractor doing the work shall accomplish all other testing.

Part 3 - Execution

- All medium voltage rated cable shall be tested in accordance with NETA testing standards.
- Medium voltage transformers, cable, and switchgear shall be tested in accordance with NETA testing standards, with a complete written report provided to Pima Facilities Operations prior to completion of the project. All testing of this equipment shall be accomplished in the presence of the Engineer or a representative of the College Facilities Management Electric Shop.
- For actual requirements of each area, verify testing requirements with the Engineer.
- All wire and cable utilized on the 120/208 and 480/277 volt systems shall be tested.

- Ground resistance testing shall utilize the fall of potential method of testing.
- All panelboards and switchboards shall be meggar tested prior to energizing.
- All connections inside of switchboards, panelboards, motor control centers, and similar equipment shall be torqued and tested prior to energizing the equipment.

End of Section 26 01 26

DIVISION 26 - ELECTRICAL

Section 26 05 00 - Common Work Results for Electrical

Introduction

The design shall be set up such that all equipment shall be provided and installed with the highest degree of quality and workmanship in both the type of equipment installed and the quality of the equipment installed.

Part 1 - General

- All work associated with the installation of electrical equipment at this site shall be accomplished by skilled workers which are experienced in the type of work for which they are to accomplish. The contractor shall be licensed to do commercial or industrial electrical work. Each work crew shall consist of a maximum of one helper for each journeyman electrician. For all work, involving the installation of medium voltage (above 600v) a contractor having a class A-17 license shall accomplish equipment the work. The workers on medium voltage systems shall be journeyman electricians. The definition for a journeyman electrician will be that the electrician shall have completed a minimum of 5 years in a combination of training and education of electrical equipment installation under the direction of skilled journeymen electricians.
- The plans and drawings are complimentary and anything indicated by either shall be required to be installed as if it were indicated on both.
- All work shall be installed and coordinated with all other trades. Conflicts shall be solved through a joint decision by the trades and shall be presented to the College for their approval.
- It is the responsibility of the contractor to visit the site prior to bid, and familiarize himself with any and all site conditions.
- Laboratory panels shall be accessible to users, not locked in electrical/mechanical rooms.
- Use of the metal clad cable, special restrictions:
 - Metal Clad (MC) cable will be permitted under the following circumstances:
 - In walls, for electrical outlets, stud wall construction, dry locations.
 - Following strict procedures regarding the routing. Each wall may have the MC cable running horizontally to adjacent receptacles. The run of MC cable shall not run horizontally to adjacent walls. Instead, the run shall go up in the wall to a J-box in the interstitial ceiling space.
 - Horizontal runs of circuitry in the interstitial ceiling space shall be in EMT or GRC. Home runs shall be EMT or GRC.
- Metal Clad (MC) cable shall meet the following:
 - It shall be steel/aluminum with factory installed conductor, stranded copper wire, each conductor color-coded.
 - The end fittings shall be Arlington Industries, SNAP 2 IT with insulated throats. Substitutions will not be considered.
- All other wiring systems shall be as specified.
- Elevators shall have their own direct feed feeders, from the main service switchboard, panel or mains.

Part 2 - Products

- All products specified for use at this site shall be UL listed or CSA certified for the use specified herein.
- Provide submittals for all equipment as indicated in the section under which it is specified in accordance with the provisions of Division 01.
- All equipment shall be protected from the elements between time of delivery to site and actual installation. No equipment shall be installed until it is obvious that no normal damage will occur to the equipment between the time of installation and the end of the contract. All equipment, whether installed or on site awaiting installation, remains the property of the contractor until the end of the contract.
- Conduit Sleeves / Concrete Walls & Floors Above Grade
 - Shall be schedule 40 steel
 - Sized for full dimensions of insulation and fire caulked where required
 - Install in all exterior walls, fire walls and floors
 - Floor sleeves to extend 1" above floor surface
- Conduit sleeves in non-rated, non-masonry walls or partitions. Provide 24 gauge galvanized steel.

Part 3 - Execution

- All work shall be accomplished in accordance with the latest NEC. A copy of the latest codebook and project specifications shall be kept at the premises during construction.
- The contractor as directed by the Construction Project Manager shall coordinate prior notice of any power shutdowns or any disruptions to existing facilities.
- All work shall be inspected prior to covering and any work covered prior to inspection will be made available for inspection at the option of the Construction Project Manager. No additional fees will be provided to uncover work covered prior to inspection.

End of Section 26 05 00

DIVISION 26 - ELECTRICAL

Section 26 05 13 – Medium-Voltage Cables

Introduction

All wire to be in conduit UNLESS APPROVED BY Pima Facilities Operations.

Design is to make conduit system available for use in future.

Maximum of three circuits in each conduit for all new installations. Remodels may have six.

Where more than one 20-amp circuit is installed in a conduit with a common neutral, size neutral conductor to #10.

MC Cable may be used for branch circuits after the home run.

Part 1 – General

- Wiring of different system voltages shall be in separate raceways separated gutter compartments required.
- Wiring color-coding to be as indicated under Section 28 05 53 – Identification for Electrical Safety and Security.
- Grounding and grounded conductors to be identified at all visible points.
- In order to provide for future wiring when calculating box fill maximum fill shall be 70% of code fill requirements.
- All power and lighting conduits shall contain a ground conductor sized per NEC 250.
- All wire shall be new.
- All wire removed from conduit shall be discarded.

Part 2 - Products

- 600-volt insulation minimum on all cables unless specified otherwise.
- All wiring to be minimum #12 AWG solid copper conductors. Only exception is for fire alarm circuits where #14 solid copper conductors shall be used.
- All wire is to be new and brought to the job site in unopened packages.
- Use THHN/THWN for all sizes between #12 and #4 AWG indoor, dry locations. Use XHHW-2 for all sizes #2 and larger or all outdoor or wet locations. Do not use #3, 300 kcmil or 400 kcmil.
- Control cabling for instrumentation shall be twisted shielded pair No. 18 ga. Minimum copper conductors with overall foil shield where used for 4 to 20ma or 1 to 10 volt control signals. For 120-volt control signals use minimum of No. 14 ga. stranded copper.
- For wire sizes #6 and smaller as appropriate for the devices, wiring may be connected using wire nut type of wiring connectors. Twist wires together before applying wire nut. Interior of nuts shall be metallic. Submit samples for approval.
- Joints in cables #6 and larger shall be made with solderless connectors. Either compression type connectors or box

lug connectors and a combination of rubber and plastic "Scotch 33" type of tape shall be used. Split bolt connectors are prohibited.

- Connections at terminal strips shall be made using either compression type of terminals or a ring or spade connector must be installed on the wire before connecting to a screw terminal. Wrapping stranded wire at a screw terminal is not permitted.
- Suitcase type connectors are disapproved.

Part 3 - Execution

- Wire shall be color coded throughout its length. Wires #8 and smaller shall be color-coded using colored insulation. Wires #6 and larger shall be identified with multiple rings or spirals of color coding tape at each box or piece of equipment.
- Use fire alarm manufacturers standard color-coding for fire alarm circuits.
- Conduit system shall be complete prior to pulling in wires.
- Use only UL approved wire lubricant. No grease or silicon, which could damage the insulation of the cable, shall be used.
- Any run of conduit, which does not permit conductors to be pulled in readily, shall be condemned and replaced to the satisfaction of the Pima Facilities Operations.
- When pulling in cables for feeders use power operated pulling equipment only where specifically approved by Pima Facilities Operations.
- Protect wires at all locations where exiting from conduits.
- Carefully cable all wires in panelboards, gutters, and wireways. Use tie wraps where needed.
- Do not use tape to cable wires either for pulling into conduits, or for cabling in panels, gutters, or wireways.
- Do not combine systems of various voltages or circuits from separate sources in the same conduit system.
 - Exceptions
 - Readily identifiable low voltage conductors for lighting system control may be run in the same conduit as the power conductors for a terminal drop to a light switch or to a single light fixture.
 - Motor control wires (not including control wiring for a VFD) may be installed in the same conduit as the power wiring if they can be installed without damaging the smaller wiring.

End of Section 26 05 13

DIVISION 26 - ELECTRICAL

Section 26 05 26.13 – Primary Grounding

Introduction

This section applies to the main building grounding electrode system. In general, this applies to new building construction or major building expansions only and is not applicable to general renovation projects.

Ground system shall be considered separate from the lightning protection system and its associated counterpoise but must be attached to each other. (Typically below grade).

Part 1 - General

- Wiring within Facilities may become a separately derived system as it relates to the distribution system supplied by the Power Company any time we have a local 4160-volt or 13,800-volt primary transformer. The design of this system should be based on that fact. Grounding shall be per article 250 of the NEC.

Part 2 - Products

- Provide a minimum 50' size 3/0 stranded bare copper conductor in the footing to provide for a base conductor or Concrete Encased Electrode ("UFER") ground for the electrical system. At each end bond out to a 3/4" x 10' copper clad or copper weld ground rod. At each of these points provide an inspection or test point.

Part 3 - Execution

- All primary and secondary service ground connections shall be made using an exothermic welding such as Cadweld.
 - Ground shall be bonded in at least one location to any underground metal water mains or copper water mains.
 - Ground shall be bonded to building structural steel at least one location and per the NEC.
 - The building ground system shall be bonded to any ground ring for lightning protection.
 - Bond to fire protection.
 - Bond to gas.

End of Section 26 05 26.13

DIVISION 26 – ELECTRICAL

Section 26 05 26.16 – Secondary Grounding

Introduction

This section shall cover all grounding from the secondary of the main supply transformer OR service entrance main disconnect and all wiring downstream of that point. All systems where the possibility of shock exists due to the lack of grounding shall be grounded.

ALL CONDUITS CONTAINING WIRING TO BE ENERGIZED AT OVER 90 VAC SHALL CONTAIN A SEPARATE GROUNDING CONDUCTOR SIZED PER NEC.

Part 1 - General

- As a minimum per NEC 250.
- Use grounding bond bushings for all feeder conduits at panelboards, switchboards, wireways, bus ducts, transformers, generators, transfer switches and any other distribution equipment.
- At panelboards only line conduits shall be required to be bonded. Load conduits for subfeed panels will also need to be bonded at each panel.
- Wherever grounding requirements are stated in specifications, consultant shall insert requirement that contractor shall submit variance requests in writing and receive approval prior to proceeding with the variance.
- Refer to drawing 26 05 26.16-D1 of this section.

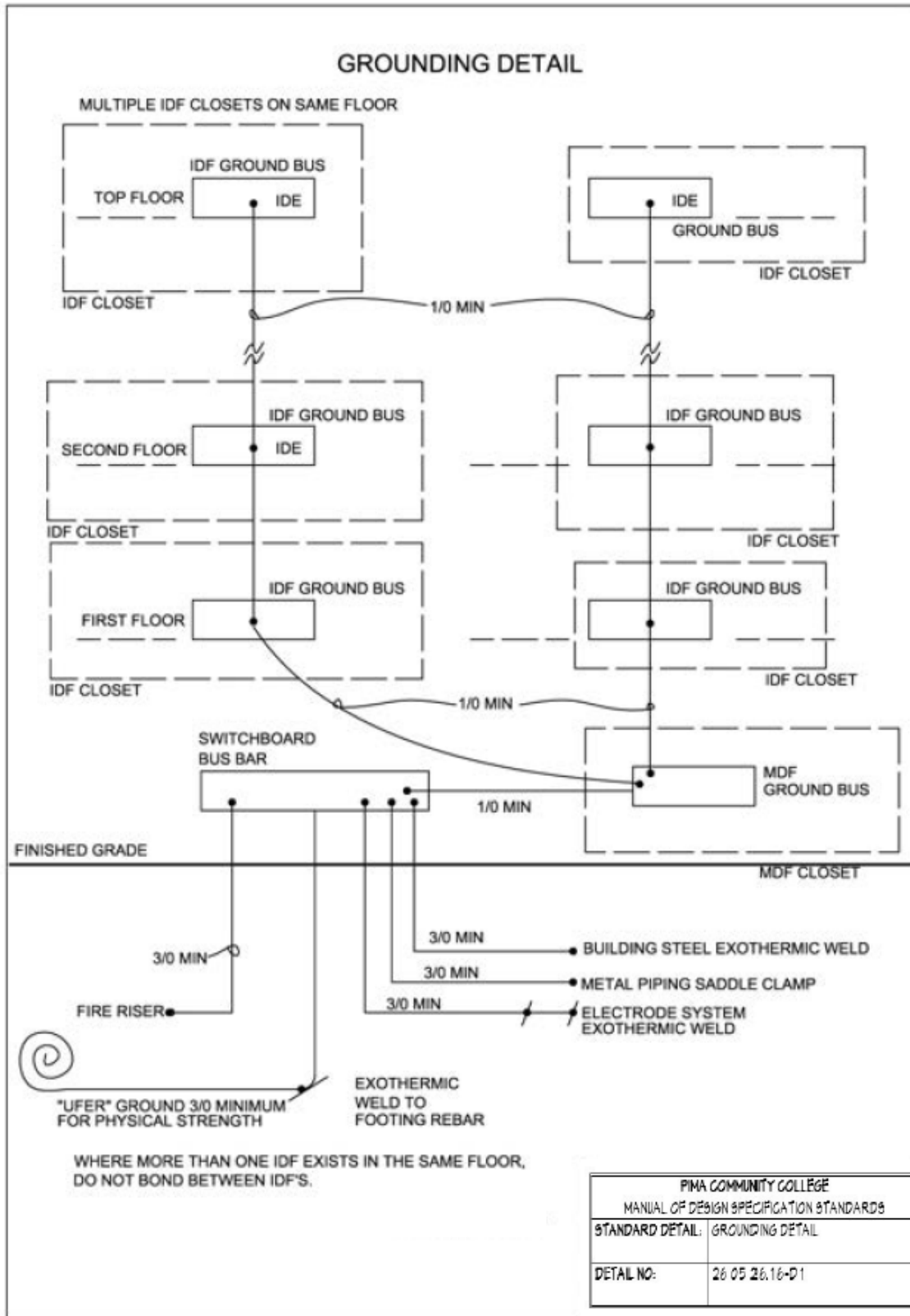
Part 2 - Products

- All grounding conductors shall be stranded insulated copper wire except factory tails.
- Minimum size ground conductor to be #12. Size to be as per NEC.
- All busducts shall contain a separate copper ground bus. This shall be bonded to the enclosure.
- Receptacle or switch bonding jumpers may be factory crimped stranded assemblies or field assembled with
- #12 insulated solid conductor.

Part 3 - Execution

- All grounding conductors shall be color coded green. This must be visible at all visible locations such as in panelboards, cabinets, enclosures, boxes, wireways, etc.
- Isolated grounding conductors shall be green with an orange or yellow tracer.
- All light fixtures shall be grounded via a ground screw in the body of the fixture. The ground screw shall not be attached to a removable entrance fitting.
- All enclosures shall be grounded.
- All j-boxes shall be grounded.

- All panelboards shall contain separate isolated neutral and ground busses. An additional isolated ground bus shall be provided where required.
- All enclosures shall be connected to the grounding conductor.
- All conduit systems shall be connected to the grounding conductor.
- Bond transformer neutral to ground at the secondary of the transformer. Do not bond at any other location. An additional ground from the building ground system shall be supplied with the size as per NEC.



End of Section 26 05 26.16

DIVISION 26 - ELECTRICAL

Section 26 05 29 - Hangers and Supports for Electrical Systems

Introduction

This section covers support requirements for conduits, light fixtures, and all other electrical equipment.

Supports as specified herein are stricter than those required by the NEC due to the increased accessibility to areas by Pima College maintenance personnel.

Part 1 - General

- All materials shall be corrosion resistant (supports, fasteners, miscellaneous hardware).
- Minimum support requirements shall be as specified in the NEC for electrical equipment. Where specified herein as more stringent the more stringent shall apply.

Part 2 - Products

- CONDUIT SUPPORTS shall be as follows:
 - Width of structural strut trapeze shall not exceed 12".
 - Where individual conduits are run on walls and where appropriate one-hole straps may be used. Where more than two conduits are run in parallel or where conduits are 1 1/2" or larger, support using approved structural strut members fastened to the structure at minimum of two points. Minimum strut length is 12 inches.
 - Single conduits trapeze above ceiling use 1/4" all thread and conduit hangers up to 1 1/2". For 2" and above use strut rack and minimum of 2 - 3/8" or larger all thread rods.
 - Wire shall not be used as a method to fasten conduits above ceilings. Conduit hangers or straps as appropriate shall be used to rigidly support the conduits in each situation. 18 gauge or larger galvanized tie wire may be used to tie conduits inside of metal stud walls.
 - Conduits above drop ceilings shall be supported independent of wire supports for drop ceilings, and shall not be supported on wires. Caddy #812MB18 box and conduit supports or equal may be used.
 - Fixture whips, however, shall be permitted to be supported by the fixtures seismic wire utilizing approved clips
 - All fasteners shall be steel threaded inserts or steel expansion shield anchors for location used. One-hole straps shall be either connected to the wall studs using appropriate screws or to the wall using expansion bolts. In hollow masonry walls, steel toggle bolts may be used. Plastic or lead expansion anchors shall not be used. No powder actuated fasteners shall be used. All fasteners shall be screw in type fasteners.
 - Sheet rock screws of any type shall not be used.
 - Fastening methods shall be subject to approval by Pima Facilities Operations.
 - One-hole conduit straps shall be Mineralac Med series or equal.
- LIGHT FIXTURE SUPPORTS in drop ceilings
 - Small incandescent or down lights to have one support wire.
 - 2 x 2 or 2 x 4 fluorescent to have (2) support wires and earthquake clips.
 - Support wires to be not less than 12 gauge galvanized steel.
 - Deflection on support wires to be not more than 30% except where approved by Pima Facilities Operations.
 - All support wire connected to structure.
 - Anchors in concrete to be not less than 3/4" diameter. Use only drill in type anchors.

- All other fixtures shall be rigidly supported from the structure.

Part 3 – Execution

- CONDUITS
 - Support on 10' centers and within 18" of boxes connector, couplings or equipment and 36" of a change in direction.
 - Support from structure.
 - Use strut frame or angle iron frame when no wall system is available.
- LIGHT FIXTURES
 - Support from structure.
 - Support independent of ceiling grid.
 - Earthquake clips.
 - Support from structure to a 500% safety factor
 - SAFETY SWITCHES, MOTOR STARTERS, PANELBOARDS
 - Use strut backing when more than 1 is surface mounted in an area.

End of Section 26 05 29

DIVISION 26 - ELECTRICAL

Section 26 05 33 - Raceway and Boxes for Electrical Systems

Introduction

The general attitude on conduit systems is that in the future any area which does not have surface mounted raceways in the area at present shall not have them in the future. New conduit in an existing gypsum board wall shall be fished with either steel/aluminum flex or EMT caps, or shall have wall notched and then patched for installation of new conduits. In addition, it is the intent of this section that conduits being installed now shall provide for additions in the future.

Reducing washers are prohibited except where approved by the Pima Facilities Operations.

The minimum size of each conduit shall be 3/4" unless noted otherwise below.

The maximum number of circuits in a new conduit is three. Remodels may add up to 6.

For homeruns, a j-box shall be located above the lights in an accessible location to allow for future expansion. No home run shall terminate in a wall mounted device box. Use a separate J-Box.

For underground utility projects, the information in Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems shall apply.

Do not substitute conduit fittings for pull boxes.

- 1/2" conduit shall be allowed where terminating to a one gang device box from an above ceiling J-box.
- Specific housing projects will permit 1/2" emt raceways in lieu of 3/4" but homeruns shall be 3/4".

Part 1 - General

- Provide a submittal for conduit, wire ways, and fittings.
- Reducing washers are prohibited except where specifically approved by the electrical inspector. A ground bushing will be required wherever reducing bushings are authorized.
- Stud to stud supports are required in all metal framing, in order to support boxes.

Part 2 - Products

- EMT
 - Use steel compression type fittings, and couplings (set screw type fittings not permitted).
 - Connectors shall have insulated throat.
 - No factory emt bends allowed below 1".
 - No Condulet type fittings over 1 1/2" unless approved by Pima Facilities Operations.
- Galvanized rigid steel (GRC)
 - No running threads.
 - Use one-piece couplings.
 - Use Ericsons only where approved by engineer.

- Double locknuts and threaded insulated steel bushings at all boxes.
- Minimum ¾".
- No Condulet type fittings over 1 ½" unless approved by Pima Facilities Operations.

- Steel/Aluminum Flex
 - Minimum size ¾" with #14 THHN wire. (For connection to an individual light fixture or with a single circuit)
 - No pre-wired raceways.
 - 1 screw compression or set screw connectors only.
 - Maximum 6' length.
 - No BX cable.
 - No MC except as noted in 26050-1 or as approved by Pima Facilities Operations.
 - Use integral insulated throat fittings.

- Liquid tight flexible conduit, steel core (LTFC)
 - Equal to Sealtight.
 - Minimum size ½". (For connection to a single motor or device with less than 5 #12)
 - Use insulated throat compression type steel connectors.
 - Maximum length 6'
 - All device wiring shall be field wired by the electrical contractor. Suitcase type connectors shall not be used. Submit samples for evaluation by Pima Facilities Operations.

- PVC
 - Schedule 40 minimum wall thickness.
 - Minimum size ¾".

- Surface Mounted Raceways
 - Shall be as manufactured by Walkerduct or Wiremold.
 - Minimum size shall be equal to type 500 WM.
 - No PVC or plastic wiremold products will be permitted.
 - Utilize manufacturer's products for all transitions from conduit systems and for all bends, offsets, or otherwise appropriate situations. Minimize field modifications to the raceway.

- Conduit bodies allowed ¾" through 1 ¼" only with approval of the Pima Facilities Operations.

Part 3 - Execution

- Conduit system must be complete prior to pulling cables.

- EMT
 - Use in gyp board walls, surface mounted in equipment rooms, and where not subject to moisture or damage. EMT to route vertically only in walls in areas with drop ceilings. No horizontal runs through walls unless specially approved by Pima Facilities Operations.
 - Condulets shall not be used indoors in place of pull boxes.
 - Route conduit not less than 1' above drop ceilings and no higher than 36" above unless approved by Pima Facilities Operations.

- Galvanized Rigid Steel
 - Use above grade where subject to weather.
 - Use where subject to moisture.
 - Use where subject to damage.
 - Use for all 90 degree bends in underground runs or in block walls.
 - Use within 5' of building walls, if penetrating the structure, in underground runs.
 - Use in all light pole bases.
 - All indoor runs larger than 4" except communications or special systems.
 - Underground or in concrete must be half lap wrapped with 10 mil PVC tape or painted with bitumastic compound.
 - Use in tunnel
 - Use at a height of 4' and below in all Electrical, Equipment and Mechanical Rooms or where subject to physical damage.

- Schedule 40 PVC
 - Use only below grade.
 - Use only with approved PVC supports.
 - Use inside of block walls, with solid grouted cells.
 - May be used as a sleeve inside of building for grounding or lightning protection wiring.
 - All stub ups shall be GRC.
 - See Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems for installation requirements (dept, encasement, etc.).

- Steel/Aluminum Flex
 - Use only where permitted by Pima Facilities Operations or for feed to lights or smoke detectors in a t-bar ceiling.
 - Use where required for fishing existing stud walls to a single device.
 - Provide sufficient length for loop at bottom of flex. (Do not draw tight).
 - Use for dropping conduit down an existing wall with limited ceiling height.

- Liquid Tight Flexible Conduit (LTFC)
 - Use only where permitted by Pima Facilities Operations.
 - It shall not be used to penetrate sheet metal enclosures.
 - Provide sufficient length for loop at bottom of flex. (Do not draw tight).

- Surface mounted raceways (Wiremold or approved equal)
 - Use in renovation projects where existing walls do not allow fishing or notching of walls. All other uses shall not be permitted without the approval of the Pima Facilities Operations.
 - Must use Wall box connection when connecting to a flush mounted wall box.
 - Must use center dividers when used for more than one system.
 - File all cuts smooth prior to installation.

Support all conduits from structure minimum of 5' centers and within 18" of a box; connector, coupling or factory 90° bend and at closer intervals where required by NEC.

Reference Section 26 05 29 – Hangers and Supports for Electrical Systems for means of support.

End of Section 26 05 33

DIVISION 26 - ELECTRICAL

Section 26 05 33.16 - Boxes for Electrical Systems

Introduction

Types of boxes - outlet and receptacle boxes, and metal junction and pull boxes. Underground concrete boxes or manholes are discussed in underground distribution systems.

Boxes are to be left in such a manner that they are both accessible for future access, and that spare space (per NEC) is available for working with additional conductors.

Part 1 - General

- DEVICE BOXES
 - NEW WORK minimum size to be 4"sq. x 2 1/8" deep with adequate space for devices, wires, and 30% spare fill capacity except as approved by the College.
 - REMODEL use flush mounted boxes in existing walls (notch GWB walls if necessary). Use 4" sq. boxes.
- JUNCTION BOXES
 - NEW WORK minimum size 4 11/16" sq. x 2 1/8" with 1/2" and 3/4" knockouts on each side. For conduits 1" and larger use boxes 6 x CS (conduit size) X 8 x CS, x 4" minimum or as per NEC 314. Provide for 30% spare fill capacity in all junction boxes. Extension boxes are not permitted.
 - All home runs shall have a j-box located in an accessible location above the ceilings (in interstitial ceiling spaces).
 - All existing junction boxes in an area remodeled shall be left accessible or relocated to an accessible location.
 - All j-boxes 4 11/16" sq. x 2 1/8" sq. or smaller shall have both 3/4" and 1/2" knockouts on all sides.
 - Ground tails shall be installed in boxes prior to rough-in.

Part 2 - Products

- DEVICE BOXES
 - Shall be galvanized steel one-piece boxes. No more than one plaster ring shall be utilized with each box. Gangable boxes or handy boxes shall not be used without prior approval of the Pima Facilities Operations.
- JUNCTION BOXES
 - Shall be galvanized steel or metal with baked enamel. Where used outdoor boxes shall be NEMA 3R rated. Where subject to corrosion shall be NEMA 4X SS.
 - For new work, no extension boxes will be permitted.

Part 3 - Execution

- DEVICE BOXES
 - No Madison clips used as supports.
 - Rigidly supported to structure independent of conduit system support.
 - Flush mounted shall not have more than 1/8" gap.
 - No back to back devices or boxes in walls unless approved. Offset all boxes in non-fire rated walls

- minimum of 6". For fire rated walls provide minimum 24" separation or use approved fire assembly.
 - Where transitioning from flush mounted j-box to surface mounted raceway, horizontally mount the plaster ring so that the proper type of wall box connection may be utilized with the surface mounted raceway.
 - Surface mounted boxes shall be 4" square boxes, with industrial raised device plates. These shall be only used in equipment rooms or where specifically approved by the Pima Facilities Operations.
 - Cut in boxes may be used in remodel applications where conduit is fished down existing stud walls.
- **JUNCTION BOXES**
 - Shall be rigidly supported to structure independent of conduit system.
 - Shall be accessible.
 - Runs between junction boxes shall not exceed 90'.
 - Shall be identified per Section 28 05 53 – Identification for Electrical Safety and Security.
 - Shall not be located more than 3' or less than 1' above a drop ceiling.
 - Covers shall be attached with machine screws only. NO self-tapping screws or wood screws shall be utilized in attaching the cover.
 - Reference Section 26 05 29 – Hangers and Supports for Electrical Systems for supports and anchors.
 - Shall not have concentric knockouts unless specifically approved by the Pima Facilities Operations.
 - Use grounding bushings on all enclosures having concentric and eccentric knockouts where such knockouts are approved by the Pima Facilities Operations.
 - No powder actuated plastic or lead fasteners. Install boxes with machine screw type fasteners.

End of Section 26 05 33.16

DIVISION 26 - ELECTRICAL

Section 26 05 43 - Underground Ducts and Raceways for Electrical Systems

Introduction

When preparing the layouts for new underground distribution for the electrical systems, future capacity shall be included to provide for expansion/modification of the services in an area. In this area common sense and a discussion with the Pima Facilities Operations and the Facilities Electrical Shop shall be used in determining how many additional conduits shall be installed in a duct run above the number needed for actual work in the project. In addition, it shall be the responsibility of the engineer doing the design to consult any and all of the as-built documentation of an area prior to laying out the duct bank for a particular area. Any changes caused by the lack of proper investigation shall be fully documented by the engineer in the form of revised drawings and not notes added to the original drawings. Fully document and detail the drawings such that major obstructions and other utility services are clearly indicated on the drawings.

Part 1 - General

- Provide submittals for conduit, fittings, manholes, handholes, and all associated appurtenances.

Part 2 - Products

- UNDERGROUND CONDUIT AND DUCT BANKS
 - Use GRS (galvanized rigid steel) or PVC schedule 40 for underground conduit and duct bank installations. Installation parameters are prescribed in Table 1 below.
 - Where required concrete encasement shall be either 2000 psi or 3000 psi.
 - Red colored concrete encasement, where required, shall use a red pigment integrally mixed into the concrete. Dry shake or broadcast coloring agents are not to be used.
 - Tape all underground GRS conduit with 10 mil PVC tape, half lapped or coat with a bitumastic compound.
 - For concrete encased conduits use manufactured PVC spacers and mounts for support and spacing of the conduits. Do not use concrete blocks or other means to support and space conduits that are to receive concrete encasement.
 - A metallic backed marking tape shall be installed 12" above all underground conduits and duct banks.
 - A #10 AWG trace wire shall be installed in all utility trenches.
- MANHOLES AND HANDHOLES
 - Minimum 12" x 18" x 12" with solid nominal I.D. concrete bottom for power or lighting runs. For High Voltage work manhole shall be sized similarly to existing manholes on campus.
 - Shall be constructed out of 3000 psi steel reinforced concrete.
 - Shall be traffic rated construction.
 - Cover shall indicate type of wiring enclosed within.
 - Shall include a securely mounted removable ladder when over 4' deep.

Part 3 - Execution

- UNDERGROUND CONDUITS AND DUCT BANKS
 - Install underground conduits and duct banks per Table 1, below, and locate a minimum of 1' from other utility systems, including phone, steam, sewer, chilled water, etc.

Underground Conduit and Duct Bank Installation Requirements			
	Above 600V	600 V and Below	Other Systems
Below Building Slabs	PVC or GRS, 36" deep, red concrete slurry	PVC or GRS, 18" deep, no concrete encasement required	PVC or GRS, 18" deep, no concrete encasement required
Outside of Building	PVC or GRS, 36" deep, red concrete encasement, 3000 psi at drive lanes. 1000 psi Slurry all other locations	GRS, 36" deep, no encasement, or PVC, 24" deep with 2000 psi concrete encasement, plain	GRS, 36" deep, no encasement, or PVC, 24" deep with 2000 psi concrete encasement, plain
Outside of Building minimum depth requirement cannot be met	Special permission required, Contact Pima Facilities Planning Department		

- Install not less than 3 - #4 reinforcing bars tied to a "U" shaped stirrups at 8' centers for duct banks under roadways.
- Concrete encased with a minimum envelope of 3" around each conduit where encasement is required.
- Minimum 3" spacing between outer diameter of conduits.
- Conduits to be used for high voltage cable shall be installed by journeyman electricians having minimum of five years' experience in the installation, splicing, and testing of high voltage wiring. Contractor shall have class A-17 license for minimum of 2 years prior to work. Refer to Section 26 05 00 – Common Work Results for Electrical.
- Use bell adapters where conduits enter manholes.
- Concrete shall be red dyed utilizing red dye mixed into the concrete for a minimum of 5 minutes prior to pouring. Minimum of 1 bag of dye per 1 yard of concrete.
- For 4" diameter and larger GRS conduit bends, minimum bending radius shall be 48". Standard factory bends may be used for 3-1/2" diameter and smaller GRS conduit bends.
- Tie banks down and stake using rebar at each support.
- Spacers and supports to be at 5' centers.
- Conduits shall be cleaned and tested for continuity prior to installation of cables as follows:
 - A steel sectional mandrel shall be pulled through the conduit. The mandrel outer diameter shall not be less than .5" less than the inside diameter of the conduit.
 - Should the mandrel become stuck in the conduit then the length of conduit where the mandrel was stuck shall be condemned and replaced to the satisfaction of Pima Facilities Operations.
 - The conduit shall then be swabbed out by pulling through a brush and/or rags, which remove any additional debris from the conduit.
 - Spare conduits shall receive a pull string and be capped at both ends. Spare conduit shall be identified as to other end. Spare conduit where subject to weather shall be sealed using a coupling and steel insert.
- MANHOLES AND HANDHOLES
 - Ring and lid shall be installed above grade so that water drains away from them.

- Shall be installed on a bed of gravel (minimum of 12" deep) with a drain hole to allow water to drain out of them.
- Shall be installed with cover flush on sidewalks.
- Shall be installed with top of cover minimum 2" above grade in landscaped areas.
- For handholes use cover appropriate to the area located.
- For manholes use traffic rated cast steel outer cover with an inner lid which can be padlocked from above. The inner lid shall be welded to the manhole ring.
- Provide a ¾" x 10' ground rod driven into the bottom of the manhole near one of the sides for grounding of wires and cables.
- Provide pulling irons opposite potential duct entrances.
- Have inset unistrut to allow for cable racks in manholes.
- HV Cable racks shall have porcelain insulators. Loop high voltage feeders around the inside of the manhole tied to the insulators.
- Manhole covers shall be manufactured with inscriptions for "Electrical" and "Communications".
- Manhole steel rings, frames and covers shall be "NIKKO". No exceptions.

End of Section 26 05 43

DIVISION 26 - ELECTRICAL

Section 26 05 53 - Identification for Electrical Systems

Introduction

To provide ready identification of power source for maintenance personnel.

Part 1 – General

- Refer to Section 28 05 53 – Identification for Electrical Safety and Security.

Part 2 – Products

- Refer to Section 28 05 53 – Identification for Electrical Safety and Security.

Part 3 – Execution

- Refer to Section 28 05 53 – Identification for Electrical Safety and Security.

End of Section 26 05 53

DIVISION 26 - ELECTRICAL

Section 26 09 00 – Instrumentation and Control for Electrical Systems

Introduction

The goal is to provide a standard Lighting Control system with ease of installation and maintenance. The removal of line voltage at the user level is also a safety consideration. The system should be able to continue to operate in the event that the control panel has a failure without impacting the operation of the building users. In addition, the controls shall be networked to allow for offsite access and control without the use of proprietary software and hardware. The system shall also interface with the building automating system (BMS) and be Niagra AX protocol compatible.

Part 1 - General

- Basis of design shall be the Wattstopper DLM series Controls. Designers shall provide submittals for approval for other systems.
- Manufactures Commissioning Agent shall provide access usernames and passwords to access the program and shall provide a back-up media for restoring the control programming to its original state in the event of complete loss of the programming.

Part 2 - Products

- All controller shall have manual override switches.
- Control Architecture shall be a “Bottom Up” type where the individual rooms shall be autonomously controlled and report status back to the controller.
- All relays, contactors and control power backs shall be rated for the overcurrent device protecting the circuit and the load that is being controlled.
- All controls shall be compatible with the lighting ballasts, drivers etc. that are being controlled and shall be coordinated during design.
- All lighting controllers shall be compatible with the Building Management Systems and shall communicate with the network without external translators.
- No system shall be designed that requires proprietary software or offsite Tech support for any reprogramming or systems diagnosis.

Part 3 - Execution

- Lighting control design shall be kept as simple as possible such that a failure of a component does not disable the entire system.

End of Section 26 09 00

DIVISION 26 - ELECTRICAL

Section 26 12 00 – Medium-Voltage Transformers

Introduction

Transformers should be mounted on a raised concrete pad a minimum of 4" above the finished floor.

At each transformer a ground ring should be supplied with a 3/4" x 10' copper weld or copper clad ground rod at each corner tied together with a 3/0 copper ground conductor. This shall supply a grounding electrode for the transformer. Exothermic weld grounding electrode conductor to transformer ground pad.

Part 1 - General

- Coordinate new building design to allow for easy removal of distribution transformers from building interiors.
- Transformers shall first be considered for outdoor placement. When indoor placement is approved, provide permanent hoisting and dolly apparatus with egress pathway for easy replacement. Utilize station transformers with a primary knife switch.
- Transformers shall be loop feed with 4-way load break switch. Mount arrestors on the spare bushings. Refer to detail 26 12 00-D1 of this section.

Part 2 - Products

- MANUFACTURER
 - Acceptable Manufacturers:
 - General Electric
 - Square D
 - Cooper
 - Cutler Hammer
- TESTING
 - Testing shall be performed in accordance with ANSI C57.12, IEEE standards 48 and 93, NEMA TRi and TR5, and ASTM D3487.
- SUBMITTALS
 - Provide complete submittals and shop drawings on the unit including the following:
 - Shop Drawings and catalog cuts
 - Sufficient information to determine compliance with specifications.
 - Include all electrical ratings, nameplate data, impedance, dimensions, weight, mounting, footprint, material, decibel ratings, terminations, temperature rise, no load and full load losses, regulation, overcurrent protection, connection diagrams, fuse sizes, fuse curves with transformer damage points, and accessories.
- POWER TRANSFORMERS
 - The transformer shall be of the non-burning or high flash point liquid filled type. The unit shall be designed for outdoor installation a temperature variations from 0 to 45 degrees Celsius at 5% to 95% relative humidity. Cooling oil shall be in accordance with ASTM D3487.

- Transformer shall have the following characteristics:

1. Continuous rating, KVA	XXX KVA
2. Number of phases	3
3. Number of windings	3
4. Frequency, hertz	60
5. Impedance, at rated KVA	5.75%
6. High voltage winding, volts	13,800
7. Low voltage winding, volts	120/208
8. Temperature Rise	65° C Resistive and 80° hot spot

- Connections:

1. High-voltage winding	Delta
2. Low-voltage winding	Wye
3. Taps 2@+/-2.5%	Yes
4. Basic Insulation Level (BIL)	
5. High-voltage winding, kV	95

- The windings shall have insulation of high dielectric and mechanical strength and shall be arranged to permit free circulation of cooling medium. Proper internal barriers shall be provided and additional insulation shall be provided on end coils to protect against line disturbances. The coils shall be adequately braced to prevent distortion due to any abnormal operating conditions. The windings shall withstand impulses, induced and dielectric test voltage in accordance with ANSI Standard C57.12.00.
 - The transformers shall be furnished with a primary no-load tap changer. The transformer shall be provided with four (4) approximately 2-1/2% full capacity taps in the high voltage winding, two below and two above normal, brought out to an externally-operated, de-energized tap changer. The tap changer handle shall be capable of being locked in any tap position.
 - The transformers shall be provided with an indicating dial thermometer, having a range from 0 degrees C. to 120 degrees C., indicating the transformer winding temperature.
 - The transformers shall be furnished with two suitable ground pads on opposite sides near the bottom. The ground pads shall include a flat finished surface with NEMA drilling.
 - The base of each transformer shall be provided with jacking pads.
 - The transformers shall be provided with an approved nameplate conforming to the requirements of ANSI Standard C57.12.00.
 - All windings shall be copper. Fillers or tie downs shall be provided for the coil windings.
 - Cores shall be rigidly braced grain oriented, non-aging silicon steel to minimize losses,
- PRIMARY EQUIPMENT
 - The primary connections shall be dead front. NOTE: Units shall have all dead front features with the exception of bolted spade type primary bushings.
 - The primary switch shall be a gang operated load break oil immersed disconnect switch.
 - The primary fuses shall be non-load rated dry well mounted current limiting primary fuses.

- The entire transformer shall be of a single unit.
- One set of spare primary fuses shall be provided for the transformer.
- Provide distribution class surge arresters in the primary terminal compartment to protect the transformer primary. The arresters shall be rated at 10kv.
- SECONDARY EQUIPMENT
 - The low voltage leads shall be brought out of the tank by epoxy, pressure tight bushings, using the standard arrangement per ANSI. The neutral terminal shall be isolated from the transformer tank. A removable bonding jumper shall be provided from the secondary neutral to ground. The bonding jumper shall be sized in accordance with the NEC.
- ENCLOSURE AND DOORS
 - The enclosure of the transformer shall be of tamper resistant construction with no exposed screws, bolts, or other fastening devices which are externally removable.
 - The doors shall be designed and constructed to guard against unauthorized entry.
 - The high voltage compartment door shall be latched with captive bolts accessible only after the low voltage door is released and opened.
 - The low voltage door shall three point latching with a pentahead type captive bolt in the door handle for additional security. Provisions for padlocking the handle shall be included whereby the padlock cannot be engaged until the captive bolt is seated.
 - Access to the tank hand hole shall be only after the low and high voltage compartment doors are opened.
 - A rigid steel partition shall separate the high and low voltage compartments.
 - The doors shall have full return baffles on the edges and have concealed latching mechanisms and hinges to provide maximum resistance to prying or probing with sticks, rods, or wires.
 - Exothermically weld pad ground conductor to transformer ground pad.
 - Transformer shall be painted sage green, federal standard 595b, color 14449 (equal is RAL 6021 and Dupont G51531BA). Sand with 220 grit paper, prime with Dupont Vari-Prime, apply 3 coats of Dupont catalyzed urethane color.
- TRANSFORMER TANK
 - Transformer tank shall be of sealed construction of sufficient strength to withstand a pressure on 7 psi without permanent distortion.
 - The following shall be provided on the wall on the tank inside of the locked low voltage compartment of the transformer:
 - Drain valve and sampling device
 - Pressure Relief valve
 - Oil filling plug
 - Oil level plug
 - Non corrosive metal nameplate
 - Ground pad
 - Oil Level gauge
 - Dial type thermometer

- Pressure/vacuum gauge
- The following shall be provided on the wall on the tank inside of the locked high voltage compartment of the transformer:
 - No load tap changer handle
 - Ground pad
 - Bayonet fusing
 - Lightning arresters
- On the door of the secondary compartment shall have provisions for mounting a 15 kv rated hot stick. Hot stick shall be provided with transformer.

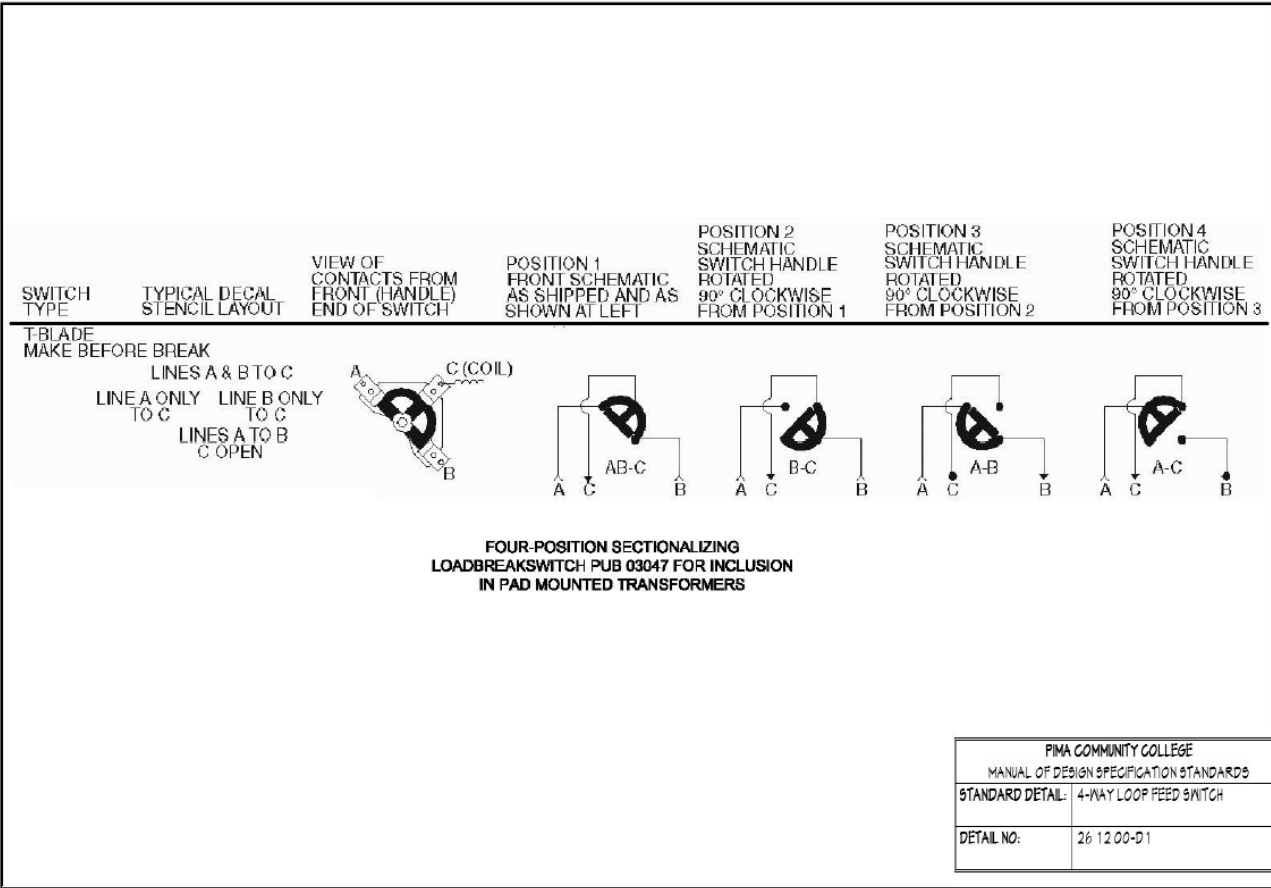
Part 3 - Execution

- INSTALLATION

- Install complete transformer pad as indicated on drawings. Pad shall have block outs for minimum of 2 additional primary and 4 additional secondary conduits.
- Transformer shall be securely bolted to the concrete foundation pad in accordance with the manufacturer's recommendations.
- Exothermically weld pad ground conductor to transformer ground pad.

- TESTING

- The manufacturer shall perform the following tests on each transformer prior to shipment and furnish the test results to the contracted Electrical Engineer.
 - Resistance measurements, ratios, polarity, and phase relation tests
 - No load core loss and exciting current at rated voltage
 - Impedance and load loss
 - Applied potential test
 - Induced potential test
 - Pressure leak test
 - Audible sound levels
 - Temperature rise
 - Impedance
 - Verification of compliance from prototype testing and conformance verification
- Notify the PCC Project Manager, in writing when the transformers are ready for field testing.
- The electrical contractor shall adjust, test, and place the equipment into operation to the complete satisfaction of the PCC Project Manager.
- All 13.8 KV equipment not utilized or in use inside or outside a building and its associated wiring shall be removed all the way back to where it originates.



PIMA COMMUNITY COLLEGE	
MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL:	4-WAY LOOP FEED SWITCH
DETAIL NO.:	26 12 00-D1

End of Section 26 12 00

DIVISION 26 - ELECTRICAL

Section 26 12 20 – Primary Power Cables

Introduction

The goal at this site is to provide looped power distribution to all buildings on the main campus power system. In addition, in the future we would also like to change the service to the College to eliminate all of the 4160-volt distribution and replace with 13.8 KV distribution. All new designs should reflect that plan. All cables should be capable of connecting to either 13.8 KV or 4160 volt systems. The cable should be tied either to an existing looped system with PMH switches or to a new looped distribution system as per Pima Facilities Operations. All cable should be shielded and run in duct banks out of the existing (or new) tunnel system.

Part 1 – General

- WORK INCLUDED
 - The Contractor shall furnish and install all shielded power cable suitable for use on this project.
- SUBMITTALS
 - In accordance with submittal and specification procedures.

Part 2 - Products

- Acceptable Manufacturers:
 - Okonite Prysmiam
 - Southwire
 - Kerite
- TYPE AND RATING
 - The cable shall be certified for normal operation at a conductor temperature of 105 degrees C; in wet and dry locations; in conduit above and below ground; in exposed cable tray runs.
 - Conductors shall also be certified for operation at 1 300C during emergency conditions and 2500C under short circuit conditions. The cable insulating and jacketing materials shall have a forty-year average service life.
 - All cable shall have the voltage ratings as hereinafter specified with ethylene propylene rubber insulation and suitably sized copper conductors. The cable shall be supplied in the quantities and number of conductors specified and for the functions as listed.
- SHIELDED POWER CABLE

Cable Type and Size	Voltage Rating
Copper Conductors	15 kV - 133% Insulation
Copper Foil Shield	

- QUALITY ASSURANCE

- Each power cable shall be given the manufacturer's standard production tests to assure that all cables adequately meet the requirements of these specifications. All cable shall conform to the applicable requirements of ICEA Publication S-68-516, UL 1072, Federal Standard 10 CFR 50, and UL Type MV 105 EPR and the latest specifications for extruded insulation. The copper conductors shall conform to ASTM-B8 for annealed copper, Class B stranded, compressed concentric round.
- Test data shall be furnished to the Owner. Test data may apply to the cables being furnished under this purchase order, or may be certified results of tests previously made on identical cables.
- Materials used in the manufacture of the cable covered by these specifications shall be of the kind, composition and physical properties best adapted to their various purposes and conform to the standards of AEIC, ANSI, ASTM, IEEE, ICEA, NEC, NEMA and UL in effect on the date of the bid-opening as to material, workmanship, design and testing. Tolerances and practices in manufacture of finished cable shall conform to the best modern shop practices.
- SPECIFIC SUBMITTAL REQUIREMENTS
 - Materials Test Reports: Where specific materials tests are herein specified or the manufacturer shall furnish where such tests are required by specific standard governing the manufacture of such materials, six (6) copies of certified test results to the Contractor who shall submit them to the Owner.
 - The Contractor shall submit certified copies of the results of all standard production tests and tests performed in accordance with NEMA, and ICEA S-66-524 Standards as required by paragraph above, "Quality Assurance".
 - Technical Data: Contractor shall submit within 30 calendar days after receipt of Notice of Award values for all technical data regarding the cable being furnished.
- DESIGN AND CONSTRUCTION
 - Conductors:
All copper conductors shall be stranded, and fabricated from uncoated, annealed copper wire conforming to ASTM B8. Stranding shall be concentric lay Class B, Standard, #2 cable.
 - Insulation:
Conductors shall be insulated with ethylene propylene flexible thermosetting dielectric compound. The ethylene content of the compound shall not exceed 72% by weight of ethylene nor shall the compound contain any polyethylene. The insulation shall be triple-tandem extruded with the conductor and insulation screens. The extruded screen shall be free stripping. The outer screen/insulated core shall be covered with an uncoated copper tape. It shall be applied helically with 12.5% nominal overlap. The overall jacket shall be polyvinyl chloride.
 - Semi-Conductor Screens:
These shall be Ethylpropylene based.
 - Identification:
All cable shall have a permanent and readily identifiable exterior surface marking at appropriate intervals along its entire length. The method of marking shall be subject to the approval of the Owner. The marking shall contain the following information:
 - Manufacturer
 - Year of manufacture
 - Size and type of conductor

- Rated voltage
 - Insulation thickness
 - Shield
 - Type of jacket
- Reels:

All cable shall be furnished on reels. Each reel shall have the diameter of the drum large enough to prevent damage to the cable from reeling. The maximum flange diameter of the reel is not to exceed 78 inches. The outer end of the cable shall be securely fastened to the reel head to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slit in the side of the reel or into a housing on the inner side of the drum in such a way as to make it available, if required, for test. The inner end shall be fastened to prevent it from becoming loose during installation. Each reel shall be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel. The reels shall be lagged. Each length of cable shall be effectively sealed to prevent the entrance of moisture. The seal shall be applied in such a way as to prevent damage to the conductors or cable.
- DATE OF MANUFACTURE
 - All cable utilized in a pull shall have been manufactured during the same production run from the factory. All cable shall be new and shall have been manufactured within 3 months of the date of receipt at the job site. Storage of cable prior to installation shall comply with the recommendations of the manufacturer.
- GUARANTEE
 - The manufacturer of the cable shall furnish medium voltage cable which shall comply with the following warranty:
 - "The manufacturer shall warrant the cable to free from defects in material and workmanship for the 40 year design life of the cable; provided the cable is employed under the conditions contemplated and covered by the design specifications, and provided further that the cable is installed, spliced, terminated, maintained, and operated in accordance with the manufacturer's recommended procedures, at the time of bid.

In the event that the cable is defective in manufacture, as determined by the manufacturer and Pima Community College jointly, the manufacturer's only responsibility will be to supply another cable for the defective portion, the new cable to be delivered free of charge to Pima Community College.

Manufacturer shall not be responsible for any defects or repairs to, or replacement of, adjacent or connected equipment to which the cable may supply electric power or from which it may take electrical power or from which it may take electrical power.

Manufacturer will not be responsible for any termination, maintenance, or operation which is not in accordance with the manufacturer's recommended standards and procedures."

Part 3 - Execution

- INSTALLATION
 - Reels shall be rolled only in the direction indicated by the manufacturer and no reel containing cable shall be dropped from a truck or from any other comparable height, under any circumstances. In turning reels, particularly after the lagging has been removed, bars shall be used in such a manner that they will not bear against the cable. Reels shall not be rolled over rocks or other projecting objects, which are liable to damage the cable, and, when it is necessary to roll unlagged reels over soft ground, plant tracks shall be provided to keep the reel from sinking with possible damage to the cable. Cable shall be carefully handled

- during installation and shall be unreeled or uncoiled slowly to prevent damage to the insulation or sheath from sudden bending. The ends of any cable used shall be kept sealed from moisture at all times, either for cables that have been pulled and are awaiting connection, or for cables on reels in storage. In no case shall cables be allowed to lie on the floor or any other location where they may be subject to damage. If necessary, temporary supports shall be provided and arranged so as not to interfere with any provisions for permanent supports, or require any cable splicing. When reeling the cable off the reels and pulling it into the conduit every effort must be made to protect the cable from damage. The cable shall not be pulled off onto bare ground, asphalt, or concrete. Wherever it is required to pull cable off the reel for a subpull it shall be necessary for the contractor to provide a surface which will not subject the cable to abrasion during the subpull.
- Sharp kinks shall be avoided in any unreeling, uncoiling, and pulling operation, and the cable shall be carefully guided and trained into conduits or other raceways in as direct a manner as possible with a minimum amount of bending. The Contractor shall be responsible for keeping any cable bends to as large a radius as feasible and, where practicable, the minimum radius shall be kept at a value no less than 12 times the outer diameter of the insulation or covering. Where conditions dictate the installation, necessary bends of a small radius will be permitted, subject to the approval of Pima Community College. Any cable pulled in a manner resulting in damage to the shielding shall be removed and replaced at the direction of Pima Community College and at the Contractor's expense. Following the installation of the cable and until such time as the splice or stress cone is made the cable shall be resealed to prevent absorption of moisture into the insulation of the cable.
 - Before any cable is pulled in any conduit, such conduit shall have been tested for and cleared of, any obstruction in accordance with the requirements of Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems. The conduit termination shall be provided with a bushing or other suitable protector to guard against damage to the insulation or outside covering. Cable may be pulled by woven basket wire grips or by attachment of the pulling device directly to the conductor. Pulling tension shall not exceed the manufacturer's recommended limits. Soapstone, or other non-hardening pulling lubricant, approved by Pima Community College electrical engineer for the type of insulation involved, shall be used to help facilitate pulling requirements. All cable installed shall be arranged, and tied where necessary, in the opinion of Pima Community College, in a neat and orderly manner. Cable shall enter and leave in neat packs and shall be arranged in such a way as not to block openings or future use. The cables shall be supported clear of sharp edges or any structural framework. Cables shall be kept clear of any obstruction while placing. Cable installation procedures shall be reviewed by the PCC Project Manager and shall be subject to the approval of the Owner.
 - Splices will not be permitted except where indicated on the drawings or where specifically approved by the engineer prior to start of work for high voltage cable. The Contractor shall furnish all materials and perform all work required for the complete termination or splicing of any wire, or cable including any stress cones that may be required. Terminations, splices and stress cones for high voltage cables and conductors shall be completed in accordance with manufacturer's recommendations or as directed by Pima Community College.
 - All high voltage cable splicing and dressing work shall be performed by men and crews thoroughly experienced (minimum five years) in such work, and each such cable splicer shall be approved by Pima Community College before splicing has begun. High voltage cable shall be given a high potential test per the requirements of Section 26 01 26 - Maintenance Testing of Electrical Systems before final termination. Where desirable, the final termination taping shall be extended over the terminal connector onto the bus or bushing of the equipment to which the conductor is attached. Final taping shall generally be applied from bottom to top to provide the best possible shield and, in wet or damp locations, terminal taping shall be painted with insulating varnish. The Contractor may use premolded slip on type splices, taps and stress-cones. These premolded devices shall be made of ethylene propylene terpolymers. All cable splices shall be approved for use by the cable manufacturer on the specific cables.

- Where T connections are approved by the PCC Project Manager, utilize bus bars with dead break elbow terminals and bushings. Use deadfront devices when they are available.
 - Incorporate attached specification as applicable into your specification.

PART 4 - Phasing and Identification

- The contractor shall verify the existing phasing on all equipment being reconnected to a new service prior to removing the equipment and shall reconnect the equipment back to match original phasing following the completion of the installation of the new service.

End of Section 26 12 20

DIVISION 26 - ELECTRICAL

Section 26 13 00 – Medium-Voltage Switchgear

Introduction

Note: Maintenance personnel shall seek Engineering assistance in applying this specification to the procurement and installation of this equipment.

Note: Consultants shall review this specification and revise it in accordance with good engineering practice and scope of the application.

Part 1 - General

- The switchgear shall be in accordance with the single-line diagram, and shall conform to the following specification.
- The switchgear shall consist of a gas-tight tank containing SF6 gas, load-interrupter switches and resettable fault interrupters with visible open gaps and integral visible grounds, and a microprocessor-based overcurrent control. Load-interrupter switch terminals shall be equipped with bushings rated 600 amperes continuous, and fault-interrupter terminals shall be equipped with bushing wells rated 200 amperes continuous or bushings rated 600 amperes continuous (as specified) to provide for elbow connection. Manual operating mechanisms and viewing windows shall be located on the opposite side of the tank from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.
- Ratings

The ANSI ratings for the integrated switchgear shall be as designated below.

Frequency, Hz Short-Circuit Current	60
Amperes, RMS, Symmetrical	25 KA
Voltage Class, kV	15.5
BIL Voltage, kV	95
Main Bus Continuous Current, Amperes	600
Three-Pole Load-Interrupter Switches	
Continuous Current, Amperes	600
Load Dropping Current, Amperes	600
Fault Closing Current, Duty-Cycle	
Three-Time, Amperes, RMS, Symmetrical	16,000
Ten-Time, Amperes, Peak	41,600
Fault Interrupters	
Continuous Current, Amperes	600
Load Dropping Current, Amperes	600
Fault Interrupting Current, Duty-Cycle	
Three-Time, Amperes, RMS Symmetrical	25,000
Ten-Time, Amperes, RMS, Symmetrical	25,000
Fault Closing Current, Duty-Cycle	
Three-Time, Amperes, RMS, Symmetrical	25,000
Three-Time, Amperes, Peak	65,000
Ten-Time, Amperes, RMS, Symmetrical	16,000
Ten-Time, Amperes, Peak	41,600

Note: Ratings with respect to this gear is based on the fault current available to the system as of October

1, 2009. Fault current analysis shall be necessary to verify these rating and/or increase them.

- Certification of Ratings
 - The manufacturer of the switchgear shall be completely and solely responsible for the performance of the load-interrupter switch and fault interrupter as well as the complete integrated assembly as rated.
 - The manufacturer shall furnish, upon request, certification of ratings of the load-interrupted, and the integrated switchgear assemble consisting of switches and default interrupters in combination with the gas-tight tank.
- Compliance with Standards and Codes
 - The switch gear shall conform to or exceed the applicable requirements of the following standards and codes:
 - The applicable portions of ANSI C57.12.28 covering enclosure integrity for pad-mounted equipment.
 - The applicable portions of ANSI C37.71, ANSI C37.72, ANSI C37.73, IEC 56 and IEC 265-1 (Class A), which specify test procedures and sequences for the load-interrupters switches, fault interrupters, and the complete switchgear assembly.
- CONSTRUCTION
 - SF6-Gas Insulation
 - The SR6 gas shall conform to ASTM D2472.
 - The switchgear shall be filled with SF6 gas to pressure of 7 psig at 68° F.
 - The gas-tight tank shall be evacuated prior to filling with SF6 gas to minimize moisture in the tank.
 - The switchgear shall withstand system voltage at a gas pressure of 0 psig at 68° F.
 - A gas-fill valve shall be provided.
 - A temperature-compensated pressure gauge shall be provided that is color-coded to show the operating range. The gauge shall be mounted inside the gas-tight tank (visible through a large viewing window) to provide consistent pressure readings regardless of the temperature or altitude at the installation site.
 - Gas-Tight Tank
 - The tank shall be submersible and able to withstand up to 10 feet of water over the base.
 - The tank shall be of welded construction and shall be made of 7-gauge mild steel or Type 304L stainless, as specified in Section 4.0.
 - A means of lifting the tank shall be provided.
 - Gas-tight Tank Finish (for mild steel only)
 - To remove oils and dirt, to form a chemical and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, mild-steel surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing drying, and cooling, before any protective coatings are applied. By utilizing an automated pretreatment process, the mild-steel surfaces of the gas-tight tank shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.
 - After pretreatment, protective coatings shall be applied that shall help resist corrosion and

protect the mild-steel surfaces of the gas-tight tank. To establish the capability to resist corrosion and protect the mild steel, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests:

- 1500 hours of exposure to salt-spray testing per ASTM B 117 with:
 - Underfilm corrosion not to extend more than 1/32 in. from the scribe, as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and
 - Loss of adhesion from bare metal not to extend more than 1/8 in. from the scribe.
- 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714.
- Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish. Certified test abstracts substantiating the above capabilities shall be furnished upon request.
- The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.
- The finish shall be indoor light gray, satisfying the requirements of ANSI Standard Z55.1 for No. 61.
- Viewing Windows
 - Each load-interrupter switch shall be provided with a large viewing window at least 6 inches to allow visual verification of the switchblade position (closed, open, and grounded) while shining a flashlight on the blades.
 - Each fault interrupter shall be provided with a large viewing window at least 6 inches by 12 inches to allow visual verification of the disconnect-blade position (closed, open and grounded) while shining a flashlight on the blades.
 - Viewing windows shall be located on the opposite side of the gear from the bushings and bushing wells so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.
 - A cover shall be provided for each viewing window to prevent operating personnel from viewing the flash that may occur during switching operations.
- High-Voltage Bus
 - Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the switchgear.
 - Before installation of aluminum bus, all electrical contact surfaces shall first be pre-pped by machine abrading to remove any oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.
- Provisions for Grounding
 - One ground-connection pad shall be provided on the gas-tight tank of the switchgear.
 - The ground-connection pad shall be constructed of stainless steel and welded to the gas-tight tank, and shall have a short-circuit rating equal to that of the switchgear.
 - When an enclosure is provided, no less than one enclosure ground pad shall be provided. The following optional feature should be specified as required:
 - One ground-connection pad per way shall be provided.
- Connections
 - For gear rated 12.5kA short circuit, load-interrupter switches shall be equipped with 600-ampere

- bushings, and fault interrupters shall be equipped with 200-ampere bushing wells.
 - For gear rated 25kA short circuit, load-interrupter switches and fault interrupters shall be equipped with 600-or 900-ampere bushings.
 - Bushings and bushing wells shall be located on one side of the gear to reduce the required operating clearance. The following optional feature should be specified as required:
 - Fault interrupters shall be equipped with 600-ampere bushings.
 - Load interrupter switches shall be equipped with 200-ampere bushing wells.
- Bushings and Bushing Wells
 - Bushings and bushing wells shall conform to ANSI/IEEE Standard 386
 - Bushings and bushing wells shall include a semi conductive coating.
 - Bushings and bushing wells shall be mounted in such a way that the semi conductive coating is solidly grounded to the gastight tank.
- BASIC COMPONENTS
 - Load-Interrupter Switches
 - The three-phase, group-operated load-interrupter switches shall have a three-time and ten-time duty-cycle fault-closing rating as specified under "Ratings." This rating defines the ability to close the switch the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished up request.
 - The switch shall be provided with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment.
 - The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.
 - The switch shall be provided with an open position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to establish a visible gap.
 - The open gaps of the switch shall be sized to allow cable testing through a feedthrough bushing or the back of the elbow.
 - Fault Interrupters
 - Fault interrupters shall have a three-time and ten-time duty-cycle fault closing and fault interrupting rating as specified under "Ratings." This rating defines the fault interrupter's ability to close the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value and clear the resulting fault current, with the interrupter remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.
 - The fault interrupter shall be provided with a disconnect with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground equipment.
 - The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.
 - The disconnect shall be provided with an open position that is readily visible through the viewing window, eliminating the need for cable handling and exposure to high voltage to establish a visible gap.
 - The fault interrupter, including its three-position disconnect, shall be a single integrated design so that operation between the closed and open positions or the open and grounded positions is

- accomplished with a single, intuitive movement.
- The open gaps of the disconnect shall be sized to allow cable testing through a feedthru bushing or the back of the elbow.
- An internal indicator shall be provided for each fault interrupter to show when it is in the tripped condition. The indicator shall be clearly visible through the viewing window.

- Operating Mechanisms
 - Load-interrupter switches and fault interrupters shall be operated by means of a quick-make, quick-break mechanism.
 - The manual handle shall charge the operating mechanism for closing, opening, and grounding of the switches and fault interrupters.
 - A single, integrated operating mechanism shall fully operate each fault interrupter or load interrupter switch in a continuous movement, so that additional operations are not required to establish open or grounded positions.
 - Operating mechanisms shall be equipped with an operation selector to prevent inadvertent operation from the closed position directly to the grounded position, or from the grounded position directly to the closed position. The operation selector shall require directly to the grounded position, or from the grounded position directly to the closed position. The operation selector shall require physical movement to the proper position to permit the next operation.
 - Operating shafts shall be pad lockable in any position to prevent operation.
 - The operation selector shall be padlock able to prevent operation to the grounded position.
 - The operating mechanism shall indicate switch position that shall be clearly visible from the normal operating position.

- Overcurrent Control
 - A microprocessor-based overcurrent control shall be provided to initiate fault interruption.
 - For dry-vault-mounted style and pad-mounted style switchgear, the control shall be mounted in a watertight enclosure, for UnderCover style and wet-vault-mounted style switchgear, the control shall be mounted in a submersible enclosure. The control shall be removable in the field without taking the gear out to service.
 - Control settings shall be field programmable using a personal computer connected via a data port to the control. The data port shall be accessible from the exterior of the enclosure. Neither external power nor energization of the gear shall be required to set or alter control settings.
 - Integral current transformers shall supply power and sensing for the control.
 - The minimum total clearing time (from initiation of the fault to total clearing) for fault interruption shall be 40 milliseconds (2.4 cycles) at 60 hertz or 44 milliseconds (2.2 cycles) at 50 hertz.
 - The control shall feature time-current characteristic (TCC) curves including standard E speed, K-speed, coordinating-speed tap, coordinating-speed main, and relay curves per IEEE C37.112-1996. Coordinating-speed tap curves shall optimize coordination with load-side weak-link/backup current-limiting fuse combinations, and coordinating-speed main curves shall optimize coordination with tap-interrupter curves and upstream feeder breakers.
 - The standard E-speed curve shall have phase-overcurrent settings ranging from 25E through 400E. The standard K-speed curve shall have phase-overcurrent settings ranging from 25k through 200K. The coordinating-speed tap curve shall have phase-overcurrent and independent ground-overcurrent settings ranging from 50 amperes through 400 amperes. The coordinating-speed main curve shall have phase-overcurrent settings ranging from 100 amperes through 800 amperes and independent ground-overcurrent settings ranging from 100 amperes through 400 amperes.
 - Time-current characteristic curves shall conform to the following IEEE C37, 112-1996 IEEE

Standard Inverse-Time Characteristic equations for Overcurrent Relays: U.S. Moderately Inverse Curve U1, U.S. Inverse Curve U2, U.S. Very Inverse Curve U3, U.S. Extremely Inverse Curve U4, U.S. Short-Time Inverse Curve U5, I.E.C. Class A Curve (Standard Inverse) C1, I.E.C. Class B Curve (Very Inverse) C2, I.E.C. Class C Curve (Extremely Inverse) C3, I.E.C. Long-time Inverse Curve C4, and I.E.C. Short-Time Inverse Curve C5.

- The control shall have field-adjustable instantaneous-trip setting (0.2 kA through 2 kA) and definite-time delay settings (32ms through 96ms for coordinating-speed tap and 64ms through 128ms for coordinating-speed main), to allow tailoring of the coordinating-speed tap and coordinating speed main curves to the application.
- Event records shall be easily extractable from the control using a personal computer connected to the data port.

- Optional Voltage Indication (Specify one of the following as required.)
 - Voltage Indication
 - Voltage indication shall be provided for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings, eliminating the need for cable handling and exposure to high voltage to test the cables for voltage prior to grounding. This feature shall include a flashing liquid-crystal display to indicate the presence of voltage for each phase, and a solar panel to supply power for testing of the complete voltage-indication circuit.
 - The voltage-indication feature shall be mounted on the covers for the viewing windows, on the opposite side of the gear from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.
 - Voltage indication with provisions for low-voltage phasing.
 - Voltage indication with provisions for low-voltage phasing shall be provided for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings, eliminating the need for cable handling and exposure to high voltage to test the cables for voltage and phasing. This feature shall include a flashing liquid-crystal display to indicate the presence of voltage for each phase, and a solar panel to supply power for testing of the complete voltage-indication circuit and phasing circuit.
 - The voltage-indication feature shall be mounted on the covers for the viewing windows, on the opposite side of the gear from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

- Switchgear Style (Select UnderCover set-vault-mounted, dry-vault-mounted, or pad-mounted style)
 - UnderCover Style
 - The switchgear shall be suitable for subsurface installation.
 - The switchgear shall be operable from grade level without exposure to high voltage.
 - Operating personnel shall be able to verify the positions (closed, open, and grounded) of the load-interrupter switches and fault interrupters while standing.
 - To guard against corrosion due to extremely harsh environmental conditions, the gas-tight tank shall be made of Type 304L stainless steel.
 - The tank shall be designed for use in typical subsurface electrical manholes and vaults that are subject to occasional flooding to a maximum head of 10 ft. (3m) above the base of the tank. The water in these vaults may also contain typical levels of contaminants such as salt, fertilizer, motor oil, and cleaning solvents. Extreme environments such as tidal water, continuous submersion, abnormally high concentration of certain contaminants, or unusually high or low pH levels should

- be evaluated on a case-by-case basis.
- For gear rated 12.5 kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 12.5 kA for 15 cycles.
- For gear rated 25 kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 25 kA for 15 cycles.
- Wet-Vault-Mounted Style
 - The switchgear shall be suitable for installation in a vault.
 - To guard against corrosion due to extremely harsh environmental conditions, the gas-tight tank shall be made of type 304L stainless steel.
 - The tank shall be designed for use in typical subsurface electrical manholes and vaults that are subject to occasional flooding to a maximum head of 10 ft. (3m) above the base of the tank. The water in these vaults may also contain typical levels of contaminants such as salt, fertilizer, motor oil, and cleaning solvents. Extreme environments such as tidal waters, continuous submersion, abnormally high concentration of certain contaminants, or unusually high or low pH levels should be evaluated on a case-by-case basis.
 - The following optional features should be specified as required:
 - For gear rated 25kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 25kA for 15 cycles.
- Dry-Vault-Mounted-Style
 - The switchgear shall be suitable for installation in a vault.
 - The gas-tight tank shall be made of 7-gauge mild steel.
 - The following optional features should be specified as required:
 - To guard against corrosion due to extremely harsh environmental conditions, the gas-tight tank shall be made of type 304L stainless steel.
 - For gear rated 12.5kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 12.5 kA for 15 cycles.
 - For gear rated 25 kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 25 kA for 15 cycles.
- Pad-Mounted Style
 - The gas-tight tank shall be made of 7-gauge mild steel.
 - The following optional feature should be specified as required:
 - To guard against corrosion due to extremely harsh environmental conditions, the gas-tight tank shall be made of type 304L stainless steel.
 - For gear rated 12.5kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 12.5 kA for 15 cycles.
 - For gear rated 25 kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 25 kA for 15 cycles.
 - Enclosure:
 - The switchgear shall be provided with a pad-mounted enclosure suitable for installation of the gear on a concrete pad.

- The pad-mounted enclosure shall be separable from the switchgear to allow clear access to the bushings and bushing wells for cable termination.
- The basic material shall be 14-gauge hot-rolled, pickled and oiled steel sheet.
- The enclosure shall be provided with removable front and back panels, and hinged lift-up roof sections for access to the operating and termination compartments. Each roof section shall have a retainer to hold it in the open position.
- Lift-up roof sections shall overlap the panels and shall have provisions for pad-locking that incorporate a means to protect the padlock shackle from tampering.
- The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
- Panel openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between panels and pane openings to guard against water entry.
- For bushings rated 600 amperes continuous, the termination compartment shall be of an adequate depth to accommodate encapsulated surge arresters mounted on 600-ampere elbows having 200-ampere interfaces.
- For bushing wells rated 200-amperes continuous, the termination compartment shall be of an adequate depth to accommodate 200-ampere elbows mounted on feed thru inserts.
- An instruction manual holder shall be provided.
- Non-removable lifting tabs shall be provided.
- The following optional feature should be specified as required:
- To guard against corrosion due to extremely harsh environmental conditions, the entire exterior of the enclosure shall be fabricated from Type 304 stainless steel.
- Enclosure finish:
 - All exterior welded seams shall be filled and sanded smooth for neat appearance.
 - To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling, before any protective coatings are applied. By utilizing an automated pretreatment process, the enclosure shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.
 - After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the manufacturers finishing system shall satisfactorily pass the following tests:
 - 4,000 hours of exposure to salt-spray testing per ASTM B 117 with:
 - Underfilm corrosion not to extend more than 1/32 in. from the scribe, as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping): and
 - Loss of adhesion from bare metal not to extend more than 1/8 in. from the scribe.
 - 1,000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714.
 - 500 hours of accelerated wreathing testing per ASTM G 53 using lamp UVB-313, with no chalking as evaluated per ASTM D 659, and no more than 10% reduction of gloss as evaluated per ASTM D 523.
 - Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.
 - 160-inch-pound impact, followed by adhesion testing per ASTM D 2794, with no chipping or cracking.

- 3,000 cycles of abrasion testing per ASTM 4060, with no penetration to the substrate. Certified test abstracts substantiating the above capabilities shall be furnished upon request.
 - The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.
 - The finish shall be olive green, Munsell 7GY3.29/1.5.
 - The following optional feature should be specified as required:
 - The finish shall be outdoor light gray, satisfying the requirements of ANSI Standard Z55.1 for No. 70.
- LABELING
 - Hazard-Alerting Signs
 - The exterior of the pad-mounted enclosure (if furnished) shall be provided with “Warning-Keep Out- Hazardous Voltage Inside-Can Shock, Burn, or Cause Death” signs.
 - Each unit of switchgear shall be provided with a “Danger-Hazardous Voltage-Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death” sign. The text shall further indicate that operating personnel must know and obey the employer’s work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.
 - Each unit of switchgear shall be provided with a “Danger-Keep Away-Hazardous Voltage-Will Shock, Burn, or Cause Death” sign.
 - Nameplates, Ratings Labels, and Connection Diagrams
 - Each unit of switchgear shall be provided with a nameplate indicating the manufacturer’s name, catalog number, model number, date of manufacture, and serial number.
 - Each unit of switchgear shall be provided with a ratings label indicating the following: voltage rating; main bus continuous current rating; short-circuit rating; fault-interrupter ratings including interrupting and duty-cycle fault closing; and load-interrupter switch ratings including duty-cycle fault closing and short-time.
- ACCESSORIES (Specify as required)
 - A USB cable kit shall be provided for connecting an overcurrent control to a user-furnished personal computer.
- ANALYTICAL SERVICES
 - Short-Circuit Analysis
 - The Design Engineer manufacturer shall provide a short-circuit analysis to determine the currents flowing in the electrical system under faulted conditions. Since expansion of an electrical system can result in increased available short-circuit current, the momentary and interrupting ratings of new and existing equipment on the system shall be checked to determine if the equipment can withstand the short-circuit energy. Fault contributions from utility sources, motors, and generators shall be taken into consideration. If applicable, results of the analysis shall be used to coordinate overcurrent protective devices and prepare an arc-flash hazard analysis of the system.
 - Data used in the short-circuit analysis shall be presented in tabular format, and shall include the following information:
 - Equipment identifications

- Equipment ratings
 - Protective devices
 - Operating voltages
 - Calculated short-circuit currents
 - X/R ratios
- A single-line diagram model of the system shall be prepared, and shall include the following information:
 - Identification of each bus
 - Voltage at each bus
 - Maximum available fault current, in kA symmetrical, on the utility source side of the incoming feeder or first upstream device.
 - Data for each transformer
 - Three-phase kVA rating
 - Percent impedance
 - Temperature rise, 65°C and 55/65°C
 - Primary voltage
 - Primary connection
 - Secondary voltage
 - Secondary connection
 - X/R ratio
 - Tap settings and available settings
 - The manufacturer shall use commercially available PC-based computer software such as Power System Analysis Frame work (PSAF-Fault) from CYME International, CYMDIST, and/or SKM Power Tools® for Windows with the PTW Dapper Module to calculate three-phase, phase-to-phase, and phase-to-ground fault currents at relevant locations in the electrical system, in accordance with ANSI Standards C37.010, C37.5, and C37.13. If applicable, an ANSI closing-and-latching duty analysis shall also be performed to calculate the maximum currents following fault inception.
- Overcurrent Protective Device Coordination Analysis
 - The manufacturer shall provide an overcurrent protective device coordination analysis to verify that electrical equipment is protected against damage from short-circuit currents. Analysis results shall be used to select appropriately rated protective devices and settings that minimize the impact of short-circuits in the electrical system, by isolating faults as quickly as possible while maintaining power to the rest of the system.
 - As applicable, the analysis shall take into account pre-load and ambient-temperature adjustments to fuse minimum-melting curves, transformer magnetizing-inrush current, full-load current, hot-load pick-up, coordination time intervals for series-connected protective devices, and the type of reclosers and their reclosing sequences. Locked-rotor motor starting curves and thermal and mechanical damage curves shall be plotted with the protective-device time-current characteristic curves, as applicable.
 - Differing per-unit fault currents on the primary and secondary sides of transformers (attributable to winding connections) shall be taken into consideration in determining the required ratings or settings of the protective devices.
 - The time separation between series-connected protective devices, including the upstream (source-side) device and largest downstream (load-side) device, shall be graphically illustrated on log-log paper of standard size. The time-current characteristics of each protective device shall be plotted such that all upstream devices shall be clearly depicted on one sheet.
 - The manufacturer shall furnish coordination curves indicating the required ratings or settings of protective devices to demonstrate, to the extent possible, selective coordination. The following

information shall be presented on each coordination curve, as applicable:

- Device identifications.
 - Voltage and current ratios.
 - Transformer through-fault withstand duration curves.
 - Minimum-melting, adjusted, and total-clearing fuse.
 - Cable damage curves.
 - Transformer inrush points.
 - Maximum available fault current, in kA symmetrical, on the utility source side of the incoming feeder or first upstream device.
 - Single-line diagram of the feeder branch under study.
 - A table summarizing the ratings or settings of the protective devices, including:
 - Device identification.
 - Relay current-transformer ratios, and tap, time-dial, and instantaneous-pickup settings.
 - Circuit-breaker sensor ratings; long-time, short time, and instantaneous settings; and time bands.
 - Fuse type and rating.
 - Ground fault pickup and time delay.
 - The manufacturer shall use commercially available PC-based computer software such as CYMTCC from CYME international and/or SKM Captor to create the time-current characteristic curves for all protective devices on each feeder.
 - As applicable, a technical evaluation shall be prepared for areas of the electrical system with inadequate overcurrent protective device coordination, with recommendations for improving coordination.
-
- Arc-Flash Hazard Analysis
 - The manufacturer shall provide an arc-flash hazard analysis to verify that electrical equipment on the system is “electrically safe” for personnel to work on while energized. An arc-flash is a flashover of electric current in air from one phase conductor to another phase conductor, or from one phase conductor to ground that can heat the air to 35,000°F. It can vaporize metal and cause severe burns to unprotected workers from direct heat exposure and ignition of improper clothing and the arc blast resulting from release of the concentrated radiant energy can damage hearing and knock down personnel, causing trauma injuries.
 - The arc-flash hazard analysis shall include the following:
 - Identification of equipment locations where an arc-flash hazard analysis is required.
 - Collection of pertinent data at each equipment location, including:
 - Transformer kVA ratings, including voltage, current, percent impedance, winding ratio, and S/R ratio, and wiring connections.
 - Protective device ratings, including current, time-current characteristics, settings, and time delays.
 - Switchgear data, including conductor phase spacing, type of grounding, and appropriate working distances.
 - Preparation of a single-line diagram model of the system.
 - Preparation of a short-circuit study to determine the three-phase bolted fault current at each location.
 - Preparation of arc-flash calculations in accordance with NFPA 70E and IEEE 1584, including:
 - Calculation of arc current in accordance with applicable guidelines.
 - Determination of protective device total-clearing times based upon the time-

- current characteristics.
 - Calculation of arc-flash incident energy level based on the protective device total-clearing times and appropriate working distance.
- Determination of appropriate personal protective equipment in accordance with risk levels defined in NFPA 70E.
- Calculation of the arc-flash protection boundary distance.
- Documentation of the results of the analysis, including:
 - Preparation of a written report.
 - Preparation of single-line diagrams.
 - Preparation of arc-flash hazard labels to be affixed to the equipment.
- The manufacturer shall use commercially available PC-based computer software such as the arc-flash module in SKM Power Tools® for Windows to calculate the incident energy category levels, in accordance with IEEE 1584.
- Analytical Service Site Visits
 - The manufacturer shall perform a site walk-down to gather:
 - Transformer ratings, including voltage, current, power, percent impedance, winding ratio, and X/R ratio, and wiring connections.
 - Protective device ratings, including current, time-current characteristics, settings, and time delays.
 - Switchgear data, including conductor phase spacing, type of grounding, and appropriate working distances.

End of Section 26 13 00

DIVISION 26 - ELECTRICAL

Section 26 15 13 – Medium-Voltage Busways

Introduction

Busduct should be used where it can effectively replace wire and cable at a competitive rate, or where it is needed to give an area a flexible distribution system.

Part 1 - General

- Acceptable manufacturers are GE, Cutler Hammer, Seimens or approved equal.

Part 2 - Products

- All busducts shall be copper bus with a steel, no ventilated enclosure.
- Shall include full size neutral.
- Shall include a half size copper ground. The duct case shall not be the system ground bus.

Part 3 - Execution

- Support on 5' centers and within 18" of any change in direction, to building structure and as required by manufacturer.
- Support at Tap box or terminal box connection.

End of Section 26 15 13

DIVISION 26 - ELECTRICAL

Section 26 17 00 - Motor Starters

Introduction

All motors shall be protected by motor starters (except for fire pump systems or where motor has internal motor protection).

Where available use 480 volt 3 phase power for all motors rated above 1/2 hp. These motors should be protected by three phase motor starters with overloads on all three phases. Where 480 volts is not available, utilize 3-phase power at 208 volts.

All motors 1/2 hp and smaller shall be 120 volt.

All motors 1 hp and larger shall utilize magnetic type of motor starters. All motors controlled through the use of control systems shall utilize magnetic type motor starters.

Where five or more starters are required in the same area, utilize a motor control center arrangement.

Where both a starter and a disconnecting means are required at the same location use a combination starter. When using automatic controls associated with the motor use a magnetic type starter. When no automatic type of control is needed use a manual motor starter.

Motor starters shall be supplied and installed by the electrical contractor. It shall be required for the Electrical design engineer to coordinate all of the sizes of the motors and indicate the sizes of the motors on the drawings. Where motor sizes shall change due to design changes by the mechanical contractor, he shall coordinate the same with the electrical contractor at no additional cost to Pima Community College.

Part 1 - General

- Acceptable manufacturers shall be Allen Bradley, General Electric, Cutler Hammer, Square D or prior approved equal.

Part 2 - Products

- All motor starters shall be NEMA size starters. No IEC type starters shall be utilized.
- Manual motor starters shall be heavy duty, rated minimum of NEMA size 0, and shall have separate replaceable thermal type overload relays.
- Magnetic motor starters shall be heavy duty, rated minimum of NEMA size 0, and shall have separate replaceable thermal type overload relays, one per phase.
- Combination type motor starters shall utilize type FRN rejection Full size fuses rated minimum of 600 volts. With magnetic motor starter as per above, separate 120 volt control transformer, hand-off-auto switch, red and green pilot lights, and minimum of two sets of auxiliary contacts. If an external control source is used then an auxiliary disconnect device is to be added to the starter to disconnect this when disconnecting power for the starter.
- Enclosures shall be NEMA 1 for indoors, NEMA 3R gasketed or the equivalent for outdoor, and NEMA 4X SS where subject to corrosion. The basis for outdoor design/construction is Cutler Hammer NEMA 3R/12.

Part 3 - Execution

- Motor starters shall be installed at an accessible location. All motor starters shall be identified in accordance with Section 28 05 53 – Identification for Electrical Safety and Security.
- Clearances as specified in NEC 110.26 shall be provided.
- Maximum height shall be +72" aff.

End of Section 26 17 00

DIVISION 26 - ELECTRICAL

Section 26 21 00 – Low-Voltage Overhead Service Entrance

Introduction

Service entrance type panelboards and switch gear shall be used wherever the service enters into the facility from the utility serving the facility.

All new buildings shall utilize service entrance switchboards sized for the load indicated. All Service entrance switchboards should utilize 100% rated power breakers for mains and 80% rated power circuit breakers. Downstream distribution may be from distribution panelboards.

- 200 – 600 Amperes; electronic with LSI
- 800 Amperes and up; insulated case with LSI, add G per NEC
- 200 Ampere and up; consider use of Pringle bolted pressure switches

Metering at the service entrance shall be as specified by the utility providing the service.

At the Main Switchboard or at the service entrance main disconnect switch the neutral conductor shall be bonded to the building or facility grounding electrode system. This system shall be as specified in Section 26 05 26.13 - Primary Grounding.

Part 1 - General

- Per NEC 230
- Consultant shall choose major protective device schemes that are easy to coordinate. Consultant shall write into the specifications in BOLD TYPE the requirement that a completed coordination study be submitted with the switchboard submittals/service submittals if not in conformance with the basis of design. Examples:
 - Do not protect 75 KVA transformers with 100 amp fuses, use 200 amp switches fused at 125 amperes.
 - Allow 4 to 1 ratios between motors, motor control centers and upstream devices.
 - Do not size transformers for demand. Downstream main devices must clear before transformer fuses.
 - Refer to IEEE Standard 141 regarding the art of planning systems.
 - Switchboard entries shall utilize pull sections that allow main devices to be “top line”, “bottom load”. Make this clear on project drawings. Drawings for projects shall clearly depict the number of switchboard sections.

Part 2 - Products

- Products should be the same as those specified for other divisions of these specifications except that they should meet the requirements of having a means of installing a bonding jumper between the neutral bus and the ground bus. Note that the ground bus should be bonded to the enclosure.

Part 3 - Execution

- The bonding jumper must be a one-piece jumper with no splices.

- The service entrance switchboard must be connected to the grounding electrode system. The minimum size of the connection should be per NEC 250-66

End of Section 26 21 00

DIVISION 26 - ELECTRICAL

Section 26 22 00 – Low-Voltage Transformers

Introduction

This section covers transformers with primary voltages to 480 volts and secondary voltages to 120/208.

Locate transformers in an area where they are accessible for inspection on a periodic basis. All transformers are to have both secondary and primary circuit protection.

Final connection to transformers shall be in sealtight or steelflex. Minimum length shall be 3'. Conduit shall be left with an ample vibration loop.

Transformer 30 KVA and larger are to be mounted on ground level with a 4" concrete housekeeping pad. Transformers may be stacked with proper clearances and prior approval of the Pima Facilities Operations.

Part 1 - General

- Transformers are to be as manufactured by PowerSmith, or approved equal.
- Contact Pima Facilities Operations for current listing of approved transformers.
- All approved units shall have been in normal production for a period of two years prior to bid date.

Part 2 - Products

- Provide 4-2 ½ % taps on each transformer 10 KVA and above. Two above rated voltage and two below rated voltage.
- Transformers shall be harmonic mitigating type. Third harmonic removal shall be considered in design. Pima will consider other types of equipment to accomplish third harmonic removal.
- Noise levels shall be 3 db below NEMA Standards, using the lower level NEMA parameter.
- Products shall be energy conserving type TP-1, or better and shall meet the latest DOE efficiency standards
- All protection shall be external to the transformer.

Part 3 - Execution

- Ground transformer neutral to building steel or approved grounding electrode system where building steel is not available.
- Bond frame of transformer.
- When transformers are wall mounted they are to be mounted using factory constructed support assemblies or prior approved supports.

End of Section 26 22 00

DIVISION 26 - ELECTRICAL

Section 26 24 13 – Switchboards

Introduction

There are no unique Pima Community College requirements.

Part 1 - General

- Reference
 - The work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- Description
 - Contractor shall furnish and install freestanding, dead-front type low-voltage distribution switchboards, utilizing group mounted circuit protective devices.
- Reference Standards
 - ANSI C37.13 – IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
 - ANSI C37.17 – Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers.
 - NEMA PB2 – Dead Front Distribution Switchboards.
 - NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - UL-891 – Dead Front Switchboards.
- Submittals
 - Shop Drawings
 - Submit shop drawings for equipment provided under this section
 - Shop drawings shall indicate:
 - Manufacture and model numbers of equipment and devices
 - General arrangement:
 - Plan view indicating overall dimensions, shipping splits and weights
 - Front elevation indicating location of devices and instruments
 - Section through switchgear showing space available for conduits
 - Seismic certification and equipment anchorage details
 - Electrical one-line drawings
 - Short circuit ratings of bus and interrupting rating of lowest rated device
 - Circuit schedules showing feeder circuit identification, device description, including trip unit or fuse clip rating
 - Schematic wiring diagram
 - Cable lug termination device

- Time current characteristics curves
 - Main breakers
 - Feeder breakers
 - Ground fault relaying
- Test data
 - Submit power distribution acceptance test reports to Engineer for review and acceptance, prior to energization of equipment.
- Instruction Manuals
 - In addition to Section 26 00 00 – General Discussion, manual shall include the following:
 - Wiring diagrams for all systems.
- Maintenance and Spare Parts
 - Provide list of recommended spare parts
- Delivery, Storage, And Handling
 - Upon completion, assembly and testing by manufacturer of equipment specified, should it be found necessary for shipping and installation purposes to disassemble equipment, match-mark parts to facilitate erection in field.
 - Mark crates, boxes and cartons clearly to identify equipment. Show crate, box or carton identification number on shipping invoices.
 - Store switchboard units in clean, dry environment protected from elements. Maintain factory bracing, packaging and wrapping.
 - Handle units in accordance with manufacture’s written handling instructions. Lift units only by manufacturers approved means.
- Provide a comprehensive specification.
 - Include the following in performing the design and specifications:
 - Pull sections shall be required.
 - Top of main device shall be line side.
 - Sections shall have steel barriers or galactic barriers between each section.
 - Metering shall be cold sequence.
 - Metering shall be Veris Industries as specified in Section 26 27 13 – Electricity Metering.
 - Suppressor shall be hard bussed and mounted in its own cubicle.
 - Areas next to last section shall be planned and marked on the floor for future extension. Provide the housekeeping pad now.
 - Integrated switchboard design is discouraged unless required by the Pima Facilities Operations.
 - Bussing and system design will address coordination of devices. Designer shall provide 4 to 1 separation on motor feeder devices and transformer feeder devices, when referenced to the upstream device.
 - Transformer feeder breakers shall be electronic, and coordinated to the transformer and its inrush.
 - Consultant shall base initial coordination on Cutler Hammer, General Electric, Seimens or Square D.
 - Provide electronic type breakers on devices below 200 amperes whenever clean coordination cannot be achieved, including elevator feeder breakers.

- NEMA 1 Construction with sprinkler shield.

Part 2 - Products

- Materials
 - Approved manufacturers, subject to submittal review are:
 - Cutler-Hammer
 - General Electric
 - Siemens
 - Square D
- Ratings
 - Assembly shall be rated to withstand fault current as shown on drawing
 - Nominal system voltage rating of switchboard shall be as shown on the drawings.
- Construction
 - Switchboard shall consist of vertical sections bolted together. Sides and rear shall be covered with removable bolt-on covers. Provide adequate ventilation within enclosure.
 - Switchboard sections shall be rear aligned. Protective devices shall be group mounted. Devices shall be front removable and load connections front accessible.
 - Assembly shall be provided with adequate lifting means.
 - Switchboard shall be suitable for use as service entrance equipment.
- Bus
 - General
 - Bus bars shall be silver-plated copper.
 - Main horizontal bus bars shall be mounted with all three phases arranged in same vertical plane.
 - Bus sizing shall be based on 65°C over 40°C ambient temperature outside the enclosure.
 - Provide a full capacity neutral bus.
 - Provide copper ground bus, sized per NEMA Standards, extending entire length of switchgear.
 - Bus Bar Connection
 - Bus bar connections shall be bolted.
 - Bus joints shall be provided with conical spring-type washers.
 - Clamp joints shall not be used.
- Wiring Terminations
 - Provide small wiring, necessary fuse blocks and terminal blocks within switchboard.

- Control components mounted within assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- Mechanical-type terminals shall be provided for all line and load terminations suitable for copper cable rated for 75°C.
- Lugs shall be provided in incoming line section for connection of main grounding conductor.
- Control wire shall be type SIS.
 - Control wire shall be bundled and secured with nylon ties.
 - Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device.
 - Current transformer secondary leads shall be connected to short-circuit terminal blocks.
 - Groups of control wires leaving the switchboard shall be provided with terminals blocks with suitable numbering strips. Provide wire markers at each end of control wiring.
- Protective Devices
 - Main Breaker
 - Main breaker shall be fixed insulated case circuit breaker, fully electronic, LSIG/LSI.
 - Breaker shall be listed for 100% continuous ampere rating.
 - Main breaker shall be provided with solid-state trip units.
 - Frame ampere ratings shall be as shown on drawings.
 - Main breakers shall be manually operated (MO).
 - Feeder Breakers
 - Feeder breakers shall be fully electronic molded case circuit breakers or Power Circuit Breakers, LSI. Thermal magnetic breakers are not acceptable.
 - Circuit breakers shall have minimum of symmetrical interrupting capacity as indicated on drawings.
 - Circuit breakers 200-ampere through 2500-ampere shall have microprocessor-based RMS sensing trip units.
 - Solid State Trip Units
 - Provide breakers, with solid-state microprocessor based trip units.
 - Unit shall consist of current sensors, solid-state trip device, flux transfer shunt trip and solid-state adjustable time/current curve shaping elements.
 - Solid state elements shall provide:
 - Long time current pickup settings and long time delay bands.
 - Short time current pickup settings and short time delay bands.
 - Instantaneous trip settings with switchable 12t ramp.
 - Ground fault pickup settings (where indicated on drawings).
 - Adjustments shall be made using non-removable, discrete steps.
 - Sealable transparent cover shall be provided over adjustments.
 - Ground Fault (where indicated on drawings):
 - Trip shall be provided as an integral part of breaker.
 - Pick-up shall be adjustable with maximum setting of 1200 amps.

- Time delay shall be adjustable.
 - Trip unit shall contain means to conduct circuit breaker tests.
 - Breaker shall be equipped with externally accessible test points to be used for field-testing.
- Customer Metering
 - Provide customer-metering compartment with hinged door.
 - Current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
 - Potential transformers including primary and secondary fuses with disconnecting means.
 - Meter shall be microprocessor-based as manufactured by Veris.
 - The unit shall display the following:
 - Phase amperes (A, B, C).
 - Phase voltage (A-B, B-C, C-A, A-N, B-N, C-N).
- Enclosures
 - NEMA 1 with sprinkler shield, indoors.
 - NEMA 3R Gasketed Enclosure, indoors and outdoors.
 - Finish
 - Exterior and interior of switchboard shall be ANSI-61 light gray. Indoors and sage green outdoors.
- Accessories
 - Lockout Devices:
 - Provide circuit breakers with integral, lockout/tag out devices.
 - Shunt trip devices:
 - Provide shunt trip bell alarms and auxiliary switches.
- Nameplates
 - Nameplates shall be secured to switchboard enclosure with screws.
 - Switchgear assembly:
 - Switchgear shall be provided with nameplate indicating manufacturer's name and drawing number.
 - In addition to name and drawing number, provided:
 - Voltage ratings (kV nominal; kV maximum design; kV BIL)
 - Main bus continuous rating (amperes)
 - Short-circuit ratings (amperes, rms symmetrical and Mva three-phase symmetrical)
 - Momentary and fault-closing ratings (amperes, rms asymmetrical)

- Control components mounted within assembly shall be marked for identification corresponding to appropriate designation on manufacture's drawings.

Part 3 - Execution

- Inspection
 - Visually inspect equipment and components at time of delivery. Submit report to Owner/Engineer with list of items to be corrected.
- Factory Testing
 - Standard factory tests shall be performed on equipment provided under this section.
 - Switchboard shall be completely assembled, wired, adjusted, and tested at factory.
 - Manufacturer shall provide 3-certified copies of factory test reports.
- Installation
 - Contractors shall install equipment per manufacturer's instructions and contract drawings.
 - Assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to floor without use of floor sills provided floor is level to 1/8 inch per 3-foot distance in any direction. Necessary hardware to secure assembly in place shall be provided by Contractor.
 - Provide 4-inch high housekeeping pad for switchboards as indicated on drawings. Pad footprint shall be size to adequately support switchboard. Bolt switchboard securely to pad.
 - Protect equipment during installation to prevent twisting or deformation, exposure to damaging environments, and work of other trades. Maintain protection until completion of construction.
 - Prior to energization, factory representative shall visually inspect switchgear installation to insure that switches and motor operators are operable and bus connections are complete.
- Field Quality Control
 - Contractor shall perform field adjustments of protective devices as required to place equipment in final operating condition. Settings shall be in accordance with approved short-circuit study, protective device evaluation study and protective device coordination study.
 - Necessary field settings of devices, adjustments, and minor modifications to equipment to accomplish conformance with approved short circuit and protective device coordination study shall be carried out by Contractor at no additional cost to Owner.
 - Immediately prior to final inspection, thoroughly clean equipment. Refinish damaged enclosures to original quality.
- Acceptance Testing
 - Perform acceptance tests on switchboard in accordance with contract documents – Power Distribution.

- Acceptance Tests. Adjust or replace equipment as needed to comply with manufacturer's specifications. Re-test device and submit new test reports.
- Equipment shall have passed acceptance tests prior to energization.
- Certified test report of standard production tests shall be available to Engineer upon request.
- Switch operators shall be tested at least once after energization.
- Training
 - Contractor shall provide training session for up to [XXX] Owner's Representatives for one normal workday at a jobsite location determined by Owner.
 - Manufacturer's Qualified Representative shall conduct training session. Training program shall consist of instruction on operation of assembly, circuit breakers, fused switches, and major components within assembly.
- Edit carefully, as required for the project.

End of Section 26 24 13

DIVISION 26 – ELECTRICAL

Section 26 24 16 - Panelboards

Introduction

Design and/or replace panelboards in a manner that provides for expansion for future requirements. For this reason no panel (as a part of the original design) should have more than 60% of the panel filled.

Panelboards shall be readily accessible where located for use by the maintenance personnel.

Wherever possible we would like to see them isolated from view of the general population in localized electrical closets so that unauthorized persons cannot operate the breakers.

The general size and construction of the panelboard should be per the required load of the area plus at least 30% spare capacity (calculated).

Minimum AIC ratings for the panel should be 10,000 AIC for 120/208 volt panels, and 14,000 AIC for 277/480 panelboards. All AIC Ratings shall be calculated and displayed on drawings. Series rating is not allowed except with approval of the Pima Facilities Operations.

No Load centers.

Must be readily accessible.

Do not install in doorways.

All circuits from multi pole breakers shall terminate in a single device or piece of equipment. Do not tie more than one receptacle from a multi pole breaker.

Main Breakers shall be fully electronic LSI type. Equal to Cutler Hammer digitrip OPTIMA.

Part 1- General

- Submittals will be required on all panelboards. Suggested manufacturers are GE, Cutler Hammer, Siemens or approved equal.

Part 2 - Products

- All busses shall be full capacity copper.
- Full capacity neutral bus.
- Computer rooms or areas with intensive (200% rated) electronic equipment shall use oversized neutral bus.
- Ground bus isolated from ground.
- Door in door piano hinged front panel.
- Factory installed main breaker with bolted connections to the enclosed bus bars.
- Main circuit breaker required where source is not within line of sight.

- 20" wide minimum cabinets.
- Cans shall be galvanized steel with blank end walls. Knockouts to be field punched.
- 120/208 volt panels shall have bolt on circuit breakers.
 - 100 A panels shall be a minimum 30 circuit.
 - 125 to 225 A panels or larger should be minimum of 42 circuit.
 - Panel sizes shall be based on full size breakers.
 - Back fed mains are unacceptable.
- 277/480 panels and distribution panelboards, shall have bolt on type circuit breakers.
- Use plated bus in NEMA 3R applications.
- Multi pole breakers shall be manufactured for that purpose and shall not be single pole breakers tied together.
- Series rated equipment shall not be used unless approved by Pima Facilities Operations.
- Distribution panelboards shall utilize fully electronic circuit breakers, LSI for sizes 100 amperes and larger.
- Fusible panelboards are not permitted.

Part 3 - Execution

- Support to 500% safety factor.
- For panels mounted flush in walls provide 1 spare 1" conduit per each 3 spare circuits or spaces. Route spare conduits to above lights or to an accessible location.
- Provide Plastic Laminate Label per Section 28 05 53 – Identification for Electrical Safety and Security.
- Mount flush wherever possible if not in electric room or equipment room. When installing in an existing building either cut into existing wall and properly support or fir out the wall.
- Maximum mounting height 6'7" to highest breaker (centerline).

End of Section 26 24 16

DIVISION 26 - ELECTRICAL

Section 26 24 19 – Motor-Control Centers

Introduction

Part 1 - General

- Related Work
 - Section 28 05 53 – Identification for Electronic Safety and Security
 - Section 26 28 16.16 - Enclosed Switches
 - Section 26 43 00 - Surge (Overcurrent) Protective Devices

- Reference
 - The work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

- Description of Work
 - All motors will be provided ready for connections.
 - This Contractor responsible for proper phase relationships, and correct motor rotation.
 - Provide power circuit wiring for each motor from source of supply to terminal box on motor including required intermediate connections at devices such as motor starter, disconnect switches, etc.
 - Provide power circuit disconnects devices unless shown or specified to be furnished by other divisions or the owner.
 - Provide connecting lugs for equipment specified in this section as well as for equipment furnished by other divisions or the owner.
 - Provide motor starters as specified for motors unless shown or specified to be furnished by other divisions or the owner. VFD drives shall be provided under Division 40 – Process Interconnections.
 - Provide control devices shown on motor schedule or as otherwise indicated.
 - Provide control wiring (except temperature control wiring) for operation, control and supervision of motorized equipment including wiring between motor starters and control devices specified and as shown on drawings.
 - Motor control wiring shall be installed in accordance with control wiring diagrams.
 - Motors ½ HP and smaller shall be served with 120 volts, single phase.
 - Motors ¾ HP and larger shall be served with 480 volt, 3 phase.
 - Starters for NEMA rated 460- volt motors 60 HP and above shall be reduced voltage starting type.
 - Reduced voltage starters shall be auto transformer type, closed transition.

- Reference Standards

ASME/ANSI A17.1	Safety Code for Elevators and Escalators
NEMA ICS 1	Industrial Control and Systems: General Requirements.
NEMA ICS 2	Industrial Control and System: Controllers, Contactors and Overload Relays, rated not more than 200 Volts AC or 750 Volts DC.
NEMA AB- 1	Molded Case Circuit Breakers and Molded Case Switches.
NEMA KS- 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volt Max.)
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

UL 580	Electric Industrial Control Equipment.
UL 845	Electric Motor Control Centers.

- Submittals
 - The design shown in the contract documents is based on the first listed manufacturer. If any of the other listed manufacturers are provided the performance of the equipment shall be equal to or exceed the first listed manufacturer and result in clean coordination and an uncompromised distribution system.
 - Shop drawings for equipment provided under this section.
- Provide a comprehensive specification.
- Include the following in performing the design and specification:
 - Centers shall be 3 phase 4 wire.
 - Center shall have main disconnecting devices.

Part 2 - Products

- Subject to submittal approval, products known to meet the College's requirements are:
 - Cutler Hammer
 - Allen Bradley
 - General Electric
 - Siemens
 - Or approved equal
- Motor Control Equipment
 - Motor Starters:
 - Starters to be equipped with temperature compensated bi-metal overload relays with manual reset.
 - Manual starter to have melting alloy thermal overload relay.
 - Thermal units shall be selected on basis of nameplate horsepower, service factor and full load amps for particular motor.
 - Thermal units shall be selected on basis of measured actual full load amps of particular motor. Sizing shall be done with motor and driven device in its final and normal operating condition. Provide temporary heaters for each starter until motor is in proper operating condition, and replace with heaters sized to actual full load amps.
 - Each starter operating at other than 120 volts single phase shall have control transformer providing 120- volt control power to supply connected load plus 100% spare capacity.
 - Transformer shall have fused primary and secondary circuits.
 - Coils and pilot lights to be 120 volt. Provide surge suppressor across coil.
 - Manual starters shall be equipped with pilot light.
 - Starters shall be equipped with the following:
 - "Hand-Off-Auto" (H-O-A) selector switch.
 - 4 NO and 4 NC set of auxiliary contacts.
 - Red pilot light to indicate motor operation.
 - Green pilot light to indicate motor stopped.

- Amber pilot light to indicate H-O-A switch in auto position.
 - Pilot lights shall be “Push-To-Test” type.
 - NEMA 3R enclosures shall also be gasketed.
- Multi speed Starters:
 - Multi speed starters shall be equipped same as single-speed starters with addition of:
 - Speed selector switch.
 - “Auto-Off-Low-High” selector switch.
 - Compelling relay.
 - Accelerating relay/timer.
 - Decelerating relay/timer.
- Reduced Voltage Motor Starters:
 - Autotransformer starter:
 - Closed transition.
- Magnetic Contactors:
 - Magnetic contactors shall be same as magnetic starters, except without overload protection.
- Motor Disconnect Devices:
 - Refer to Section 26 28 16.16 – Enclosed Switches for disconnect switches not located in motor control centers.
 - Provide disconnect device with type FRN rejection full size fuses rated minimum of 600 volts Connected in line side of each starter.
 - Provide non-fused disconnect device at all motors.
 - Provide non-fused disconnect device at motors located on roof or located on floor different from overcurrent protective device.
 - Disconnect device shall be capable of being locked in open position.
 - Disconnect devices shall be:
 - Heavy-duty safety switch, quick-make, quick-break, horsepower rated.
 - Fused disconnect switches shall be equipped with Class RK-5 time delay fuses.
- Individual Starters and Disconnect Devices
 - Starter and disconnect device shall be installed in common enclosure, combination type, with accessories mounted in enclosure front except as scheduled.
 - Provide padlocking facility for one to three padlocks to lock disconnect in either ON or OFF position with door open or closed.
 - Provide mechanical interlock to prevent opening of door unless disconnect is in OFF position. Provide defeater to by-pass this interlock.
 - Remote disconnect switches for motors supplied from variable frequency drives (VFD) shall be equipped with pivot arm electrical interlock kit consisting of 4 NO and 4 NC contacts. Contacts to break control circuits before main switchblades open and close control circuits after main switchblades close.
 - Enclosures shall be: NEMA 1, NEMA 4X SS or NEMA 3R/12 by the spaces they are installed. NEMA 4X SS enclosures shall be required in, mechanical rooms, the main electrical equipment room, generator room, main emergency electrical room and for enclosures located exposed to the weather.

- Motor Control Centers
 - Install starters and disconnects in motor control centers, except where shown to be remote mounted at motor location.
 - Provide main breaker in the MCC, fully electronic type LSI/LSIG.
 - Motor Control Centers Shall Be:
 - 480Y/277 Volts, 3 phase 4 wire.
 - NEMA 1 enclosure indoors and NEMA 3R gasketed enclosure outdoors.
 - NEMA Class II.
 - NEMA Type B wiring.
 - Structure shall:
 - Consist of one or more vertical sections joined together to form a freestanding assembly.
 - Be minimum of 90" high, 20" wide and 15" deep for front mounted units or 20" deep for back-to-back units.
 - Have base channels with holes for bolting to floor.
 - Be designed to add matching sections on either end at future date.
 - Bus:
 - Bracing at 65,000 amps symmetrical.
 - Shall be copper-tin plated.
 - Horizontal Bus amp as shown on plans.
 - Vertical bus size shall be same size a horizontal bus size.
 - 50% Ground Bus size per NEMA standard.
 - 400 AMP MCC's shall have each section rated 400 AMP.
 - 300 AMP sections are not permitted.
 - Wire ways:
 - Horizontal wire ways at top and bottom of structure.
 - Vertical wire way full height of each section.
- Lifting Eyes
 - Provide permanent mounted lifting eyes on all equipment shipped to the site for installation by the Contractor. Lifting eyes shall be heavy duty forged steel, located to facilitate equipment installation and removal and shall not be removed after construction is complete.

Part 3 - Execution

- Installation
 - Provide 120 volts to each temperature control panel.
 - Install disconnects and motor control equipment as indicated. Final location of devices shall be determined in field.
 - Provide NEMA 4 disconnect switches at exterior mounted equipment.

- Each motor terminal box shall be connected to rigid conduit system with maximum 18" of flexible liquid-tight metal conduit.
 - Provide green wire ground through flexible conduit to interconnect motor frame and rigid conduit system.
 - Check for proper rotation of each motor.
 - Install fuses per manufacturer's instructions.
-
- Elevator Connections
 - Provide power wiring from source through circuit breaker disconnect to elevator controller to motor.
 - Coordinate entire installation with elevator equipment supplier prior to rough in.
 - Installation shall comply with ASME/ANSI A17.1: Safety Code for Elevators and Escalators.

End of Section 26 24 19

DIVISION 26 - ELECTRICAL

Section 26 25 13 – Low-Voltage Busways

Introduction

Busduct should be used where it can effectively replace wire and cable at a competitive rate, or where it is needed to give an area a flexible distribution system.

Part 1 - General

- Acceptable manufacturers are GE, Cutler Hammer, Seimens or approved equal.

Part 2 - Products

- All busducts shall be copper bus with a steel, no ventilated enclosure.
- Shall include full size neutral.
- Shall include a half size copper ground. The duct case shall not be the system ground bus.

Part 3 - Execution

- Support on 5' centers and within 18" of any change in direction, to building structure and as required by manufacturer.
- Support at Tap box or terminal box connection.

End of Section 26 25 13

DIVISION 26 - ELECTRICAL

Section 26 27 13 – Electricity Metering

Introduction

Metering shall be provided at the location where each building receives its service. In general, the metering shall be located at the main switchboard for the building.

Metering shall consist of a separate meter for each building with local plain language annunciation at the switchboard.

Metering shall be through the use of potential transformers and 3 current transformers located in the main switch board at the building.

Metering shall have the capability of being tied into a separate system where all meters can be monitored from a separate remote control system.

For all new buildings, the meters shall be tied into the existing Building Control System.

Part 1 - General

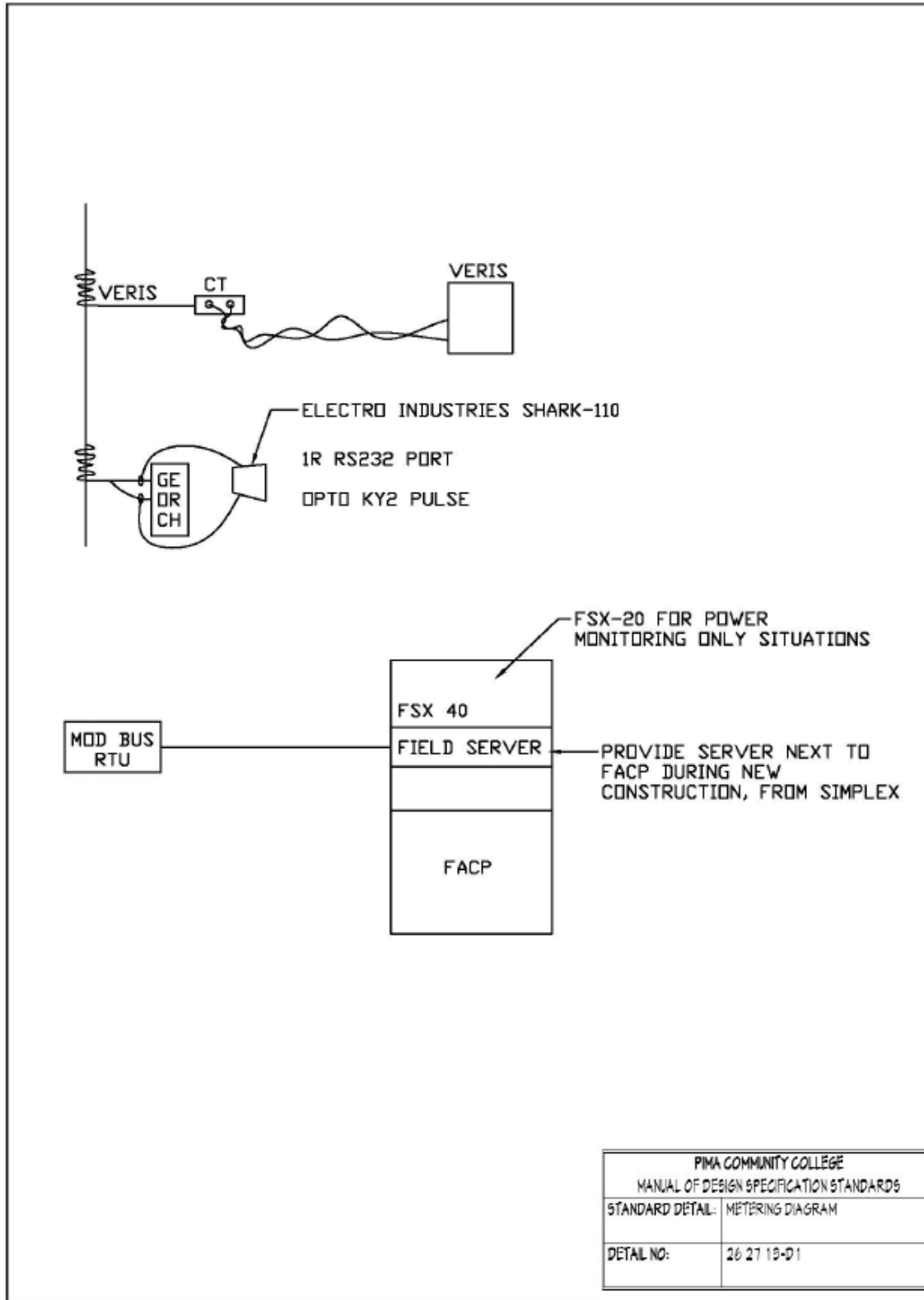
- Metering system shall have the capability of reading KWH, Max KW Demand, KVA, KVARs, Volts, Current, THD Voltage, THD Current frequency and power factor in the same system with the capability of transmitting that data to a central system where that data can be read at a central control station.

Part 2 - Products

- Provide a 1" conduit between the meter and MDF.
- New Switchboard Construction
- New boards shall be equipped with cold sequence metering. Metering section shall utilize factory installed CT's, PT's and meter. Additionally, the board will be fitted with a VERIS INDUSTRIES meter, switchboard manufacturer installed. The factory metering compartment shall be factory fitted with VERIS INDUSTRIES Hawkeye 8163 Meter and H 8163-CB Communication Board and H8936/8932 Network Display. Contractor or approved equal shall provide rigid/emt raceway from metering compartment to the building MDF telephone terminal board and provide com cable between switchboard meter section and TTB. Provide new RS 485 jack at TTB. Meter compartment shall be dead-front with lugged swing out panel cover. Interior shall have mounting board in place.
- Other Construction
- New and existing building services without switchboards shall be equipped with the VERIS system described for switchboard systems. Where existing space will allow, provide a CT com. On new construction, provide a CT com.

Part 3 - Execution

- All programming for setup of meters shall be supplied and accomplished as a part of the contract. Set intervals so as to store 1 year of KW demand data.
- An identification tag shall indicate any and all multipliers at each meter. Tag shall be an engraved tag with minimum of 1/4" high letters and secured to switchboard using either screws or rivets.
- Incorporate the following diagram, 26 27 13-D1 of this section, into the project drawings.



End of Section 26 27 13

DIVISION 26 - ELECTRICAL

Section 26 27 16 - Electrical Cabinets and Enclosures

Introduction

Since this is typically a special item used only on specific items, this section shall be as specified for the particular project and shall be worked out between the Design Engineer and Pima Facilities Operations.

Part 1 - General

No discussion.

Part 2 - Products

No discussion.

Part 3 - Execution

No discussion.

End of Section 26 27 16

DIVISION 26 - ELECTRICAL

Section 26 27 26 – Wiring Devices

Introduction

The design should take into account not only what type of equipment is to be connected to the device but also what type of loading will occur on the circuit when determining the number of receptacles on each circuit.

- Designers shall provide at least one outlet on each wall unless construction with doors and walls prevent sensible construction.
- Minimum of one convenience circuit shall be installed in each individual office.
- Maximum of six receptacles on each circuit for office areas.
- Dedicated circuit for copiers.
- Dedicated circuit for laser printers.
- Dedicated circuit for microwave.
- Hallway receptacles shall be connected to circuits, which are independent of the office or other room receptacles.
- Wall switches shall be on the latch side of doors according to the architectural plans. Where two level switching is used switches shall be in the same J-box. Motion sensors with override button shall only be installed in specific situations approved by Pima Facilities Operations.

Part 1 - General

- Due to the rough treatment of devices at this facility industrial quality heavy duty specification grade devices and receptacles are used.

Part 2 - Products

- Pass & Seymour, Arrowhart, Leviton, and Hubbell are approved manufacturers. Hubbell shall be the basis of design.
 - All devices shall be heavy-duty specification grade plug back wired minimum 20 A rated devices. Included here are standard wall outlets, light switches, GFCI, and IG receptacles.
 - Receptacles shall have a one-piece brass strap and grounding system.
 - Color of devices shall match the existing for main campus modifications, and ivory for AHSC and all new construction.
 - Devices used for emergency power shall be red.
 - Isolated ground devices shall be orange.
 - All wall plates shall be stainless steel, satin finish, minimum of .035" thick.

- Exterior device plates shall have separate covers for each section of the device. Plate shall be constructed of either polycarbonate or cast aluminum. The unit shall be rain tight with plug in use.
- Lighted toggle switches shall be used in all electrical, mechanical, equipment rooms and in tunnels. Color shall be white or clear. Wire so that they glow when the power is off.

Part 3 – Execution

- Install receptacles with the ground stab up in vertical mounting or neutral stab up in horizontal mounting.
- Install such that devices are either perpendicular or parallel to the floor or adjacent walls.
- All devices shall be pigtail connected and not used as a terminal strip or feed through connector for devices down line.
- Receptacles shall be mounted at 18" above finished floor to center.
- Lab receptacles shall mount minimum of 6" above counter top. (Except where using countertop mounted devices, manufactured for that purpose.) Max height shall not exceed 42".
- Light switches shall mount at +42 above finished floor to center.
- All receptacles shall be identified per Section 28 05 53 – Identification for Electrical Safety and Security.
- Install wiring under back wiring clamp without use of Stak-ons or crimp terminals except at ground terminals.
- Receptacles not installed in back splashes can be installed vertical above counters.
- Provide samples for approval.

End of Section 26 27 26

DIVISION 26 - ELECTRICAL

Section 26 28 16.16 - Enclosed Switches

Introduction

Disconnect switches shall be used where required to meet OSHA standards for a disconnecting means within line of sight and no more than fifty feet of the actual piece of equipment being controlled.

All disconnect switches shall be heavy-duty motor rated switches.

All disconnect switches required for compliance with OSHA shall be lockable.

A disconnect switch is not to be used as a substitute for a motor starter but should be used in conjunction with all motor starters where required as a disconnecting means.

Part 1 - General

- Acceptable manufacturers should include:
 - General Electric
 - Square D
 - Seimens
 - Cutler Hammer
 - Allen Bradley
 - Approved equal.

Part 2 - Products

- Safety switches shall be heavy-duty motor rated with fuses provided to protect downline equipment where required.
- NEMA 3R Environments shall be specified as NEMA 3R/12 gasketed.

Part 3 - Execution

- The maximum mounting height for safety switches should be 6'0" to the top. Safety switches should be rigidly mounted in place.
- Must be readily accessible per NEC.
- Label per Section 28 05 53 – Identification for Electrical Safety and Security.

End of Section 26 28 16.16

DIVISION 26 - ELECTRICAL

Section 26 29 23 – Variable-Frequency Motor Controllers

Introduction

Refer to Section 40 97 00 – Variable Frequency Drives for VFD parameters and provide coordination to include mechanical trades.

Part 1 - General

- Note that it will be necessary to interface with the mechanical or instrumentation engineer as to what required connections are necessary for the tie into the EMCS or other control system
- Do not locate drive inside of air handling units unless a dedicated power and control space accessible from the exterior is provided.
- Require complete submittals including wiring diagrams and recommended spare parts at the submittal.
- Require submission of complete operation and maintenance manuals at time of completion of contract prior to conducting the “training session”. Operation and maintenance manual shall contain a complete copy of the submittal documents.
- Require a factory representative startup and training on site four-hour minimum training session to be scheduled after the VFD is in service and fully operational.

Part 2 - Products

- Refer to Section 40 97 00 – Variable Frequency Drives.
- Fully transistorized PWM type drives.
- Coordinate use of VFD rated motors with mechanical trade.

Part 3 – Execution

- Utilize Process Interconnection Division, Section 40 97 00 – Variable Frequency Drives in coordination with the mechanical trade and/or engineer.
- Limit length of feeder from VFD or AFC (adjustable frequency controllers) to motor as per recommendations of the manufacturer. If possible, locate drive near motor.
- Feeder must be in steel conduit.
- Control wiring in separate steel conduit. Speed signal wiring to be in twisted shielded pair, minimum of 18 ga. copper.
- Install AY.

End of Section 26 29 23

DIVISION 26 - ELECTRICAL

Section 26 32 13 – Engine Generators

Introduction

The design for emergency power generation takes on two separate designs. For the typical building, it is generally used only to provide power to emergency lighting and similar building maintenance type pieces of equipment. In some other buildings, additional loads are added for such things as freezers or other types of mechanical equipment, which need to be on due to worry about losses of expensive equipment (including some valuable experiments) which are stored in the freezers. However the design for expansions on the AHSC campus sometimes take on a different flavor since it may include areas which could someday become part of the hospital. For this reason it will be necessary to discuss in great detail the design of the emergency generation system with the Engineer, prior to the proposal of the system. As a part of the design, the following items should be taken into account:

- In general, we require that the fuel type for any new emergency generators be #2 diesel. Be aware that we may require natural gas or bio-fuel units from time to time. Coordinate needs with the CPM.
- Make sure that the generator will be adequately cooled in case of loss of power to the general building system. It may be necessary to provide additional capacity for the generator just to cover an additional fan coil unit to provide cooling to the generator room if it is located inside of a closed room in the building.
- Provide for adequate exhaust from the building in a location where the fumes will not be sucked into the building air conditioning system during normal or emergency conditions.

In addition, it may be decided that some of the emergency generator systems will in the future be used for peak shedding. For this reason it is important that the generator provided be of a top brand of manufacture and designed for more than just an occasional run emergency operation. Engine generators shall be site tested for rated output plus 10% for 1 continuous hour, connected for temperature, based on capability to operate continuously at 115°C ambient. (Refer to base specification.)

As a part of the design development documents, provide a load calculation that is used for providing the basis for the sizing of the emergency generator. Take into account that at least 30% spare capacity shall be provided for in the design of the emergency generator.

As part of the plans design, make sure that the required circuits for the battery charger and the engine oil and manifold heaters are shown and provided.

Remote control or annunciation panels shall be shown on the drawings with all wiring required.

Show ATS (automatic transfer switch) and all associated wiring on the plans. Fire alarm shall monitor generator run and report to Dispatch thru the Server (refer to Section 26 27 13-2 – Electricity Metering).

For your use a copy of an existing specification for an emergency generator specification and an automatic transfer switch have been provided. (See attached appendix specification Sections 26 32 13 – Engine Generators and Section 26 36 23 – Automatic Transfer Switches). As a minimum, all of the areas covered in this specification shall be covered. This specification can be provided on disk for your use, however it is still the responsibility of the engineer to provide a complete specification for this design.

Where a building EMCS system is available, connect the following items to the system. Building power off, generator power on, generator alarm (a common alarm of all generator alarm functions).

Part 1 - General

- Provide complete submittals on the emergency generator, including at least 4 copies of all operations and maintenance manuals. Submittal information shall include documentation of fuel efficiency based on a KW per pound of gas. The engineer should provide this for evaluation prior to approving the use of any brand of emergency generator set.
- Provide distribution for legally required loads and optional loads as outlined in Article 700,701 and 702 of the applicable NRC-70. This shall include, but not be limited to, telephone equipment, servers, cooling for telephone and server equipment and elevators. (elevators where required by ANSI 17, SFM or ADA)

Part 2 - Products

- The generator should be the product of top quality generator manufacturers such as Caterpillar or Waukesha. Other manufacturers may be considered based on submittal information. The manufacturer should certify that the generator is capable of providing the necessary power for all of the load as designed, including the spare capacity.
- Generator shall have an onboard circuit breaker for load bank testing without having to disconnect the load feeders from the generator.
- Engine Generator System shall have a 5 year extended warranty. Whenever the transfer switch manufacturer offers an extended warranty, it shall be included,
- The contractor shall provide (2) complete sets of parts and repair manuals for all engine, generator and transfer switch systems and components.

Part 3 - Execution

- The generator shall be bolted to a housekeeping pad and if in a building shall have a containment area built around to contain any oil or antifreeze spills. The generator shall be installed and connected to meet with the requirements of the manufacturer.
- Provide a resistive load bank test of all generators prior to acceptance. Minimum tests should show all required control options of the generator and transfer switch as well as a one-hour load bank test at 80% load and an additional one-hour load bank test at 110% load, corrected for temperature of 115° C. Generator shall also be tested in a full load live situation test prior to acceptance.

End of Section 26 32 13

DIVISION 26 – ELECTRICAL

Section 26 32 13.13 – Diesel-Engine-Driven Generator Set

Note:

All items shown in red require review, and possible input, for information required that is specific to the generator system being specified.

The items shown with {brackets like this} are included for the purpose of establishing the levels of performance, quality and reliability required for the specified product, and ensuring the reputability of the product supplier.

The brackets should be removed in any final specification.

Part 1 - General

- DESCRIPTION OF SYSTEM
 - Provide a Standby power system to supply electrical power in event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.
- REQUIREMENTS OF REGULATORY AGENCIES
 - An electric generating system, consisting of a prime mover, generator, governor, coupling and all controls, must have been tested, as a complete unit, on a representative engineering prototype model of the equipment to be sold.
 - Conform to N.E.C. and applicable inspection authorities. NFPA 110
- MANUFACTURER QUALIFICATIONS
 - This system shall be manufactured by GENERAC, Cummins, Caterpillar or approved equal who has been regularly engaged in the production of engine-alternator sets, and associated controls for a minimum of twenty years, thereby identifying one source of supply and responsibility.
 - The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.
- DEALER QUALIFICATIONS
 - The supplier of the generator set shall be the authorized dealer for the manufacturer and the installation of the generator set shall be within the authorized dealers' assigned territory.

Part 2 – Engine Generator Set

- **Engine**
 - The diesel engine shall be a liquid cooled, four (4)-cycle design. It shall have turbo-charging and after- cooling as required by the manufacturer to produce the required horsepower in the ambient conditions specified herein. The design may be in line or V type with a minimum displacement adequate to generate the specified kW at manufacturers published rating. The nominal rating shall be kW, at .80 power factor and operating speed of 1800 RPM. Standard published data sheets must be provided that describe derations applicable to site specific ambient conditions to allow determination of acceptability of the unit proposed, Interpretation

will be determined by Pima Community College Project Manager. Engine shall be lubricated with a positive displacement oil pump.

- The engine is to be cooled with a unit-mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating within a normal engine coolant level. The radiator shall be designed for operation in 115°F Fahrenheit, ambient temperature.
- The intake air filter, with replaceable element, must be mounted on the unit. A positive displacement lube oil pump shall supply full pressure lubrication. The engine shall have a replaceable oil filter with internal bypass. Engine coolant and oil drain extensions must be provided to outside of the mounting base for cleaner and more convenient engine servicing. The fan and all rotating parts must have guards installed for personnel safety.
- The engine shall have a battery charging DC alternator with a solid-state voltage regulator. Remote 2- wire starting shall be by means of a solenoid shift, electric starter.
- Electronic isochronous governor to maintain alternator frequency within $\pm .5\%$ from no load to full load alternator output shall govern engine speed. Steady state regulation is to be $\pm .25\%$.
- The engine fuel system shall be designed for operation on No. 2 diesel fuel. A secondary fuel filter, water separator, manual fuel priming pump, fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture.
- Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature shutdown, low coolant level shutdown, over speed shutdown and over crank shutdown. These sensors are to be connected to the control panel using a wiring harness with wire number labeling on each end of the wire run for easy identification. A molded rubber boot to cover the electrical connection on each sensor to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and external impact.
- Provide the following items installed at the factory:
 - The generator set manufacturer of adequate voltage and amperage capacity to start and operate the engine shall provide a heavy duty, lead acid battery set. Provide all inter- cell and connecting battery cables as required.
 - Provide an automatic dual rate battery charger with an automatic equalizer system to monitor and limit the charge current to 10 amps. Provide an Ammeter and Voltmeter on the face of the charger, and a replaceable fuse accessible from the front of the automatic battery charger.
 - Primary diesel fuel filter capable of removing contaminants of 10 microns or larger. Element shall be replaceable cartridge type.
 - The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust to the exhaust system.
 - The engine shall have a unit mounted, thermostatically controlled water jacket heater as an aid for quick starting. It will be of adequate wattage as recommended by the engine manufacturer. The contractor shall provide proper branch circuit from normal utility power source.
- The fuel system shall include a double walled, UL approved, sub-base mounted fuel tank with electrical stub-up area. The fuel tank shall provide for a minimum of 24 hours run time at 100% of full load. It shall have the structural integrity to support the engine-generator set. Minimum features shall include all welded construction, fuel filler cap, fuel gauge, low fuel level alarm, tank rupture basin alarm, supply line check valve, fuel supply connection, fuel return connection, main tank vent, rupture basin vent and tank drain fitting. Tank must be pressure tested to 5 PSI during manufacturing. Appropriately sized flexible fuel supply and return lines shall be provided and installed.

- Appropriate vibration isolation (elastomeric or springs as required) is to be provided between the generator set and the fuel tank base. Additionally, cork/rubber type vibration isolation pads shall be provided for field installation between the fuel tank base mounting rails, and the concrete mounting pad.

- LUBRICATION SYSTEM
 - The lubrication oil pump shall be a positive displacement type that is integral with the engine and gear driven from the engine gear train. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.
 - The bypass valve must be integral with the engine filter base of receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.
 - System shall utilize synthetic lubricants with compatible filtration, and compatible engine seals, approved by the engine manufacturer.

- GOVERNOR
 - The engine governor shall control engine speed and transient load response within commercial and ISO 8528 tolerances. It will be selected, installed, and tested by the generator set manufacture.

- GOVERNOR, ELECTRONIC-SPEED CONTROL
 - The engine governor shall be a Woodward 2301 Electronic Speed Control with EG Electro- Hydraulic Actuator or Barber Coleman Equal. Speed drop shall be externally adjustable from 0 (isochronous) to 10% from no load to full rated load. Steady state frequency regulation shall be +/-0.25 percent.

- **Alternator**
 - The alternator shall be a 4-pole revolving field type, 12 lead, wired for / VAC, 30, 60 Hz, brushless with PMG excitation. The stator shall be direct connected to the engine to insure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation, and operate within Class "F" standards for extended life. All leads must be extended into an AC connection panel. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker. Maximum temperature rise at the required kW shall not exceed 130°C above 50°C ambient.

 - One-step load acceptance shall be 100% of nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6. The generator set and regulator must sustain 300% short circuit current for a minimum of 10 seconds.

 - A solid-state digital voltage regulator must be used to control output voltage by varying the exciter magnetic field to provide \pm 1% regulation during stable load conditions. True RMS sensing shall be utilized. Should an extremely heavy load drop the output frequency, the regulator shall have a Volts/Hertz capability to maximize motor starting ability. The frequency at which drop operation begins must be adjustable, allowing the generator set to be properly matched to the site-specific load characteristics insuring optimum system performance. The voltage regulator shall meet MIL-STD- 461C Part 9 for radiated and conducted emissions susceptibility when mounted within the alternator standard connection box. The voltage regulator shall be fully encapsulated for protection against moisture or abrasive contamination. It shall be tested to MIL-STD-705 Method 711.1C and salt fog tested to ASTM B117-73

- **Voltage Regulator – Sealed**
 - The manufacturer of the engine - generator set, shall manufacture the automatic voltage regulator. The volts/hertz regulator shall sense line-to-line three phases of generator output voltage and exhibit the

following characteristics:

- Generator output voltage maintained within +/- 1% of rated value for any load variation between no load variation and full load variation.
- Generator output voltage drift no more than +/- 1/2% of rated value at constant temperature.
- Generator output voltage drift no more than +/- 1% of rated value within a 40° change over ambient temperature range of -40° C to 70° C.
- Generator frequency change not over ¼ cycle no load to full load and back.
- Response time less than 20 milliseconds.
- Telephone Influence Factor (TIF) of less than 50.
- Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.
- The regulator shall include the following features:
 - Voltage level rheostat to provide generator output voltage adjustment of 25% to +10% of nominal.
 - Gain adjustment to provide output voltage compensation for changes in load or frequency.
- It is the responsibility of the generator set supplier to verify that the motor starting ability of the generator set being proposed is capable of handling the maximum starting load as shown on the plans. The maximum voltage dip during any sequence shall not exceed 30%. Mathematical confirmation in writing shall be included with the bid to assure that the generator set proposed is sized appropriately for the specific application. This confirmation shall be performed utilizing the computerized sizing program from the alternator manufacturer.
- A NEMA 1 panel that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. The generator set manufacturer to insure proper sizing must include an isolated neutral lug.
- The electric plant shall be mounted with vibration isolators on a welded steel base that shall permit suitable mounting to any level surface. Note: If fuel tank type base is included, the spring isolators are to be installed between the generator set rails and the fuel tank. (See 2.1.11.)
- A fully electronic main line circuit breaker 100% rated with long time, short time adjustments and as shown on the drawings, must be mounted in the AC connection panel. The line side connections are to be made at the factory. A system utilizing a manual reset field circuit breaker and current transformers is unacceptable. Circuit breakers of 1000 amps and above require ground fault. Breaker shall be adjustable for 110% load testing. Refer to Section 2.4.6.
- Thermal Class 200 magnet wire as described by NEMA Magnet Wire Standard MW 1000, Section MW35-C, shall be used for rotor and stator windings. The windings shall consist of copper magnet wire. All winding insulation materials shall be Class H.
- **Controls**
 - All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 1 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting, a fused DC circuit to protect the controls and a +/-5% voltage adjusting control. This panel must be able to be rotated 90 degrees in either direction for correct installation as the site may require.
 - The engine-generator set shall contain a complete 2-wire automatic engine start-stop control that starts the engine on closing contacts and stop the engine on opening contacts. A programmable cyclic cranking limiter shall be provided to open the starting circuit after five attempts if the engine has not started within that time. Engine control modules must be solid-state plug-in type for high reliability and easy service.
 - The panel shall include; analog meters to monitor AC voltage, AC current and AC frequency with a phase selector switch, a mushroom style emergency stop switch, an audible alarm, battery charger fuse, and a

programmable engine control and monitoring module.

- The programmable module shall include a manual, off, auto switch; four LEDs to indicate 1) Not In Auto, 2) Alarm Active, 3) Generator Running, 4) Generator Ready; a data entry keypad and a digital display panel.
- The module will store and display all pertinent unit parameters including:
 - Generator Status
Current unit status in real time
 - Instrumentation
Real time readouts of the engine and alternator analog values
 - Oil pressure
 - Coolant temperature
 - Fuel level
 - DC battery voltage
 - Run time hours
 - Generator Commands
Current engine start/stop status
 - Alarm Status- Provide Audio Visual Alarm Panel. Current alarm(s) condition
 - High or low AC voltage
 - High or low battery voltage
 - High or low frequency
 - Low or pre-low oil pressure
 - Low water level
 - Low water temperature
 - High and pre-high engine temperature
 - High, low and critical low fuel levels (where applicable)
 - Overcrank
 - Overspeed
 - Unit not in "Automatic Mode"
 - 8 user programmable digital channels
 - 4 user programmable analog channels
 - Alarm Log
Memory of last fifty alarm events
 - Operating parameters
Access to and manipulation of the current operating parameters and alarm limits
 - Software Information
Version information and module display test function
 - Overvoltage and undervoltage protection.
- The panel must be accessible by PC based software via either standard RS232, RS485 or modem. The software must display the module face, be updated in real time and allow for complete access to all module functions. Communication output and its software must be fully compatible and allow for incorporation into an existing control program.
- The following equipment is to be installed at the engine-generator set manufacturer's facility:
 - The panel mounted voltage adjuster must have a shaft-locking device to avoid unintentional adjustment.
- The following equipment is to be provided by the engine-generator set manufacturer and shipped loose with the unit:

- Provide an alarm annunciator panel for remote mounting with the following signals indicating status and possible malfunction. The annunciator must have the capability of programming the audible alarms as follows:

LAMP LEGEND	LIGHT	AUDIBLE
Pre-Alarm High Water Temperature	Yellow	Selectable
Pre-alarm Low Oil Pressure	Yellow	Selectable
High Coolant Temp/Low Coolant Level	Red	Yes
Low Oil Pressure	Red	Yes
Low Coolant Temperature	Yellow	Selectable
Low Fuel	Yellow	Selectable
High Battery Voltage	Yellow	No
Not In Auto	Red	Yes
RPM Sensor Loss	Red	Yes
Over Speed	Red	Yes
Low Battery Voltage	Yellow	Yes
Overcrank	Red	Yes
Generator Power	Yellow	No
Normal Utility Power	Green	No
System Ready	Green	No
Alarm Switch Off	Red	No
Generator Running	Yellow	No
Battery Charger Failure	Yellow	Selectable
Emergency Stop	Red	Yes
Communications OK	Green	Yes

The panel shall have an ALARM switch that when moved to the OFF position silences the audible alarm. A TEST/RESET switch must be included to verify the lights are functional and reset any condition after it has cleared inside enclosure.

- Engine Start Stop Control-Mushroom Switch.
- Engine run monitor, simplex CZAM/ZAM, connected into fire alarm loop. Refer to single line diagrams for the project.
- **Unit Accessories and Misc.**
 - Weather protective sound attenuating enclosure: The engine-generator set shall be factory enclosed in a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be coated with electrostatically applied paint, baked and finished to manufacturers' specifications. The enclosure shall be completely lined with 1" thick, UL 94 HF-1 listed, sound deadening material. This material must be of a self-extinguishing design. The enclosure is to have large, hinged, removable doors to allow access to the engine, alternator and control panel. Hinges and all exposed fasteners will be stainless steel. Each door will have lockable hardware with identical keys. Padlocks do not meet this specification. The critical silencer shall be included to further reduce the unit sound level. The overall design must be such that sound level is 75dbA at 7 meters (23 feet) or less.
 - Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be of critical grade to attenuate the sound to the level noted above. It shall be supplied with a flexible, seamless, stainless steel exhaust connection. A rain cap will be supplied to terminate the exhaust pipe. These components must be properly sized to assure operation without excessive backpressure when installed. Maximum backpressure is 6.7 kPa. Pitch piping to drain.

- Jacket water heater(s) shall be provided to maintain coolant temperature of 32 C (90F) while the engine is idle. Heaters shall accept 208-volt AC single-phase power and include adjustable thermostats.
- ISOLATOR-SPRING TYPE
 - Steel spring isolators shall be installed between the generator set base and the mounting surface. The isolators shall bolt to the base, and have a waffled or ribbed pad on their bottom surface. The pads shall be resistant to heat and age, and impervious to oil, water, antifreeze, diesel fuel, and cleaning compounds.
- ENCLOSURE – STANDBY PACKAGE, FULL
 - The enclosure shall offer protection as specified by OSHA from all moving and hot parts of the engine, generator and radiator. It shall be constructed to allow full access to the engine for maintenance without exposing personnel to any moving machinery. Radiator and radiator fan assembly shall be totally enclosed with lockable door over the radiator cap. The radiator shall be sized to accommodate any resulting airflow restriction. Provision shall be made for a duct flange or perforated metal grill to protect the radiator core. Doors shall be the lift off hingeless type with lockable stainless steel security latches
 - Louvers shall allow sufficient airflow to allow full load operation of the generator set. The louvers shall be twisted to deflect water and direct noise downward. The enclosure shall satisfy IEC 1P22 requirements for drip proof construction acceptable for outside installation when doors are in place.
 - The enclosure shall be fitted to the generator set base and isolated from engine vibration. Corners shall be formed and welded to assure strength and rigidity. Sheet metal with minimum thickness of 2.0 mm for enclosure and 1.2 mm for doors shall have no burrs or sharp edges. Inside and outside surfaces shall be finished with a baked high performance enamel. Exposed fasteners shall be minimized with all hardware stainless steel.
 - Outdoor generator enclosures shall be sage green, Federal standard 595b, 14449.
- CIRCUIT BREAKER-GENERATOR SET MOUNTED
 - The circuit breaker shall be mounted and connected in a guarded drip-proof enclosure. Cable lugs shall be provided for customer connections.
 - One molded case electronic circuit breaker, three pole, and single-throw, stationary- mounted with manual operating handle, overload and short circuit trips, complete with cable lugs. Overcurrent trip shall be 100% rated and sized to provide enclosed and ambient temperature compensation. The breaker shall be qualified for 600-volt operation and tested in accordance with UL Standard 489, LSI / LSIG. Breaker shall be adjustable to allow for 110 % output test.
 - One shunt trip, 24 volt DC, on circuit breaker wired to terminal board.
 - Three current transformer, 5-ampere secondaries.
 - One ground connection point.
- REMOTE ANNUNCIATOR PANEL
 - NFPA-99 requirements for remote annunciation shall be satisfied by a remote mounted electro-mechanical panel which includes red and yellow indicating lights and silenceable alarm horn for low oil pressure shutdown, low coolant temperature alarm, high coolant temperature, shutdown, overcrank, overspeed shutdown, battery charger malfunction (via charger switch), generator on load (via customer switch). Install where directed by the College.
- WEATHERPROOF SOUND ATTENUATION ENCLOSURE
 - Enclosure shall be sound attenuating enclosure: the engine-generator set shall be factory enclosed in not

less than a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of waste and include a drip edge. The enclosure shall be coated with electrostatically applied paint, baked and finished to manufacturers' specifications. The enclosure shall be completely lined with not less than 1: thick, UL 94 HF-1 listed sound deadening material. This material must be of a self-extinguishing design. The critical silencer shall be included to further reduce the unit sound level. The overall design must be such that sound level is 75dbA at 7 meters (23 feet) or less.

- Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be of critical grade to attenuate the sound to the level noted above. It shall be supplied with a flexible, seamless, stainless steel exhaust connection. A rain cap will be supplied to terminate the exhaust pipe. These components must be properly sized to assure operation without excessive backpressure when installed.

Part 3 – Automatic Transfer Switch

- Refer to specific specification for this apparatus.

Part 4 – Submittals

- Submittals shall include but not be limited to:
 - Component List - A breakdown of all components and options including switchgear.
 - Technical Data - Manufacturer produced generator set specification or data sheet identifying make and model of engine and generator, and including relevant component design and performance data.
 - Engine:
 - Type, aspiration, compression ratio, and combustion cycle. Bore, stroke, displacement, and number of cylinders.
 - Engine lubricating oil capacity.
 - Engine coolant capacity without radiator. Engine coolant capacity with radiator.
 - Coolant pump external resistance (maximum). Where remote radiator is specified
 - Generator: Model
 - Model
 - Frame Insulation class
 - Number of Leads Weight, total Weight, rotor
 - Air Flow
 - At rated voltage:
 - Efficiency at 0.8 power factor for: 50% load, 75% load, 100% load Fault current, 3 phase symmetrical
 - Decrement curve
 - Radiator: (High Ambient, Brass)
 - Model
 - Type
 - Coolant capacity, radiator
 - Coolant capacity, radiator and engine
 - Weight: Dry, Wet
 - System:
 - Dimensions: Length, Width, Height
 - Weight: Dry, Wet
 - Performance in 115°F air, 2400 MSL.

Continuous power rating at 0.8 power factor (KW) kVA rating

Fuel consumption at standard conditions for:
50%, 75% and 100% load heat rejection to:
coolant, after-cooler, exhaust, atmosphere from engine, and atmosphere from generator
Exhaust gas stack temperature
Exhaust gas components; % NOX, % SO
Tons particulate/yr/mo at 50%, 100% load
Verification of 10% overload capability

- Transient response of frequency and voltage for the generator set:
- Auxiliary Equipment - Specification or data sheets, including switchgear, spring type vibration isolators.
- Drawings - General dimensions drawings showing overall generator set measurements, mounting location, and interconnect points for load leads, fuel, exhaust, cooling and drain lines.
- Wiring Diagrams - Wiring diagrams, schematics and control panel outline drawings published by the manufacturer in Joint Industrial Council (JIC) format for controls and switchgear showing interconnected points and logic diagrams for use by contractor and owner.
- Warranty Statements - Warranty verification published by the manufacturer.
- Service - Location and description of supplier's parts and service facility including parts inventory and number of qualified generator set service personnel.

PART 5 - Execution

- EXECUTION
 - The following articles and paragraphs are intended to define acceptable procedures and practices of inspecting, installing, and testing the generator set and associated equipment.
- PREDELIVERY INSPECTION
 - The system manufacturers' local dealer at the dealer's facility to insure no damage occurred in transit and all genset components, controls, and switchgear are included as specified herein must perform a pre-delivery inspection.
- PREDELIVERY TESTING
 - Prior to delivery and acceptance, the generator set shall be tested to show it is free of any defects and will start automatically and carry full load with all parasitic and external loads. This testing shall be performed at the facility of the system manufacturer's authorized local dealer.
 - The testing shall be done on dry type, resistive load banks.
 - The load banks shall not be dependent on the generator control instruments to read current and voltage on each phase. Rather, the test instrumentation will serve as a check of the generator set meters.
 - Load bank testing shall be done in the presence of the owner's engineer or his appointed representative. After manufacturers approved break-in procedure, sample oil, change oil and performance testing, forward oil test results to PCC Project Manager. Testing shall be for a minimum of 1 hour at 80% load, 1 hr. at 100% load, 2 hrs. at 110% load, 1.0 pf. Demonstrate voltage dips and frequency dips with block loading. Bypass output circuit breaker for 110% testing. Use 125% rated conductors into load bank.

- The bidder shall furnish all consumables necessary for testing. The bidder at his own expense shall correct any defects that become evident during the test prior to shipment to the jobsite.
- SHIPMENT TO JOBSITE
 - Delivery shall be FOB to the jobsite by the system manufacturer's authorized dealer.
- INSTALLATION
 - The installation shall be performed in accordance with shop drawings, specifications, and the manufacturer's instructions.
- FIELD QUALITY CONTROL
 - A representative of the system manufacturer's authorized local dealer shall check the complete installation for procedural and operational compliance. The generator set dealer shall provide the engine lubricating oil and antifreeze, as recommended by the system manufacturer. If different manufacturers furnish switchgear and generator sets, technical representatives of both manufacturers' authorized dealers shall verify the installation meets requirements. Any deficiencies shall be noted and corrected by the Contractor.
 - The system manufacturer's dealer representative shall be present to assist the Contractor during start-up, systems check, adjusting, and site testing required after the installation is complete. Re run the pre delivery test and then test the oil. (Do not change the oil.)
- POST-INSTALLATION TESTING
 - Following installation, the system manufacturer's local dealer representative in the presence of the owner's engineer or designated appointee shall perform the following tests.
- PRESTART CHECKS
 - Oil level
 - Water level
 - Day tank fuel level
 - Battery connection and charge condition
 - Air start supply pressure (if so equipped)
 - Engine to control interconnects
 - Engine generator intake/exhaust obstructions
 - Removal of all packing materials
- OPERATION
 - Load - two hours operation at 80% of full load rating. One-hour operation at 100% of full load rating and one hour at 110°C. After the first half-hour stabilization period at full load, the following shall be recorded at fifteen-minute intervals (starting at time equals "zero"):
 - Voltage, amperage, frequency
 - Fuel pressure, oil pressure and water temperature

- Exhaust gas temperature at engine exhaust outlet
- Ambient temperature

- If equipped with appropriate instrumentation:
 - Kilowatts
 - Power Factor
 - KVARs
 - Generator Temperature

- Proper operation of controls, engine shutdown, and safety devices shall be demonstrated.

- ORIENTATION
 - The system manufacturer's authorized dealer shall provide a complete orientation for the owner's engineering and maintenance personnel. Orientation shall include both classroom and hands-on instruction. Topics covered shall include control operation, schematics, wiring and diagrams, meters, indicators, warning lights, shutdown system and routine maintenance.

- SERVICE MANUALS AND PARTS BOOKS
 - The system manufacturer's authorized local dealer shall furnish three copies each of the manuals and books listed below for each unit under this contract:
 - OPERATING INSTRUCTIONS - with description and illustration of all switchgear controls and indicators and engine and generator controls.
 - PARTS BOOKS - that illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).
 - PREVENTATIVE MAINTENANCE INSTRUCTIONS - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.
 - ROUTINE TEST PROCEDURES - for all electronic and electrical circuits and for the main AC generator.
 - TROUBLESHOOTING CHART - covering the complete generator set showing description of trouble, probable cause and suggested remedy.
 - RECOMMENDED SPARE PARTS LIST - showing all consumables anticipated to be required during routine maintenance and test.
 - WIRING DIAGRAMS AND SCHEMATICS - showing function of all electrical components.

 - All manuals and books described above shall be contained in rigid plastic pouches.

- WARRANTY NAMEPLATE
 - A warranty nameplate of not less than 152 mm x 203 mm (6 in x 8 in) must be affixed to the generator set with the following data:
 - Warranty Period:
 - Start-up Date:
 - Termination Date:
 - Supplier Name:
 - Supplier Address:
 - 24-Hour Emergency Number:
 - Preventive maintenance to be performed by:

- OIL SAMPLING SERVICE
 - The generator set supplier shall provide a scheduled oil sampling service to monitor engine condition on an ongoing basis. The sampling method shall be of the atomic absorption spectrophotometry method.
 - Immediate notification of critical results shall be provided to the owner's representative.

Part 6 – Unit Options

- FACTORY TESTING
 - Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:
 - Verifying all safety shutdowns are functioning properly.
 - Single step load pick-up per NFPA 110-1996, Paragraph 5-13.2.6.
 - Transient and voltage dip responses and steady state voltage and speed (frequency) checks.
- OWNER'S MANUALS
 - Three (3) sets of owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included. Also, include a copy of the manual on CD.
- INSTALLATION
 - Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the Engineer.
- SERVICE
 - Supplier of the electric plant and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications.
 - The supplier of the generator set shall include a maintenance contract in a form that is ready for execution by the owner if the owner should choose. The maintenance contract may not be intended for execution by a third party in any form thus ensuring and maintaining sole source and responsibility for all items supplied.
- WARRANTY
 - The manufacturer against defective materials and factory workmanship shall warrant the standby electric generating system components, complete engine-generator and instrumentation panel for a period of 5 years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. In addition, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.
 - The generator set supplier thus assuring a single source of responsibility shall conduct the execution of all

warranty.

- The manufacturer shall include the option for any extended warranties that may be available in the bid. Any added cost and conditions for this option shall be clearly stated.
- STARTUP AND CHECKOUT
 - At the jobsite.
 - Ensuring the engine starts within the specified time.
 - Verification of engine parameters within specification.
 - Set no load frequency and voltage.
 - Test all automatic shutdowns of the engine-generator.
 - Perform a load test of the electric plant; ensuring full load frequency and voltage are within specification by using building load.
 - After the above tests are completed satisfactorily, a four-hour full load test utilizing resistive load banks shall be conducted. Logging of pertinent data every fifteen minutes shall be included. The engineer shall approve the load test format before the test commenced. The owner shall provide initial fuel fill and fuel for testing.
- SUBMITTALS
 - Provide seven complete sets of Engineering Submittal for approval, prior to production release, showing all components, in addition to the engine and generator. Submittals shall include a statement of compliance with these specifications.
- SUBSTITUTIONS
 - The Standby power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel and exhaust components have all been sized and designed around the basis of design Engine Generator. Should any substitutions be made, the contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs that may result from such substitutions. Alternate equipment suppliers shall furnish equipment submittals 14 days prior to bid date for approval to bid. As part of the submittals, the substitute manufacturer shall supply as a minimum engine, alternator and control panel wiring diagrams and schematics.

End of Section 26 32 13.13

DIVISION 26 – ELECTRICAL

Section 26 32 13.16 – Gas-Engine-Driven Generator Set

Part 1 - General

- PROJECT NO.
 - The requirements specified in GENERAL - general requirements of this project shall apply to and govern the work under CSI Division I except where indicated in the following articles.
- WORK INCLUDED
 - Provide all labor, materials and equipment to furnish, install and place in operation a natural gas power generation system in accordance with the contract documents and manufacturer's drawings and installation instructions. These specifications also describe requirements for the design, fabrication and testing of the power system. The total installation shall conform to manufacturer's recommendations.
 - The installation of the power generation system shall include the following:
 - Engine-driven generator set
 - Control system Cooling system
 - Connection to natural gas system Generator set accessories Mounting system
 - System control and switchgear Base slab and vibration isolation
 - Weatherproof housing, sound attenuated
- RELATED WORK
 - Refer to the following specifications for related mechanical and electrical considerations:
 - Section 26 00 00 – General Discussion
 - Section 26 36 23 - Automatic Transfer Switch
- SYSTEM DESCRIPTION
 - The electric power generating system shall have a site capability of xxx kw, xxx kva, under continuous standby operation.
 - The system shall consist of a natural gas generator set which includes all controls, protection, output circuit breaker, wiring, and accessories for automatic start-stop operation.
 - The overload capability shall be in excess of this rating, at extreme limits of parameters specified, for not less than 1 hour.
 - Where air temperature extremes are not the case, test results will be extrapolated. The results shall be as interpreted by Pima Community College Project Manager.
 - The generator set shall include the capability of automatically controlling generator set operation. After starting, the unit will attain rated speed and voltage, and accept rated load. The engine governor shall control generator set speed, while generating output voltage regulation shall be a function of the generator automatic voltage regulator. Manual adjustment of generator speed and voltage shall be provided.
 - The generator set start-stop sequence shall be initiated manually or automatically by closing or opening of a

contact. The control system shall automatically engage the cranking motor, sense engine starting speed, disengage the motor and arm the engine protection circuit.

- The set shall immediately shut down in the event of overspeed, low oil pressure, high water temperature and overcrank. A light annunciator shall indicate cause of shutdown. System logic shall prevent restart until fault is cleared.
- There shall be a provision for manual shutdown in the event of an emergency.
- SITE CONDITIONS
- The operating environment of the power generating system shall be:

Altitude	2400 ft.
Engine room temperature, max	125 F
Outside temperature, min	20 F
Outside Temperature max	115 F
Fuel type	Natural Gas
Fuel pressure (gas)	Verify pressure for specific site by contacting PDC

- SYSTEM PERFORMANCE, GENERAL

- The power generating system shall conform to the following performance criteria:
 - Rating - Engine brake horsepower shall be sufficient to deliver full rated generator set KW/KVA at the installation site when operated at rated rpm and equipped with all engine- mounted parasitic and external loads such as radiator fans and power generators.
 - The Gas engine shall be able to deliver rated power when operating on dry natural gas having a low heating value (LHV) of 905 Btu/cu ft (33.74 kJ/L).
 - Gas Engine fuel rates shall be based on fuel having a low heating value (LHV) of 905 Btu/cu ft. (33.74 kJ/L).
 - Start Time and Load Acceptance - Engines shall start, achieve rated voltage and frequency, and be capable of accepting load within 10 seconds when properly equipped and maintained.
 - Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.
- The power generating system shall satisfy the following performance criteria at site conditions:

Total Power Capability	xxx Kw
Frequency	60 Hz
Voltage	480/2771/3 phase 4 wire
Voltage Dip starting Largest Motor sequence	20%
Power Factor	0.8
Overload for 1 Hour	10%

- The individual generator set shall exhibit the following performance capability: Caterpillar xxx model. Other manufacturers are Waukesha, Cummings, Onan, Generc, prior approved. Contact Robert Cousy, P.E., (621-9252) for approval prior to bid due date.
- QUALITY ASSURANCE
- The complete power generation system, including engine, generator, and switchgear shall be the product of one manufacturer who has been regularly engaged in the production of complete generating systems for at least 10 years. All components shall have been designed to achieve optimum physical and performance

compatibility and prototype tested to prove integrated design capability. The complete system shall have been factory fabricated, assembled, and production tested as performed by Caterpillar, or prior approved systems.

- RESPONSIBILITY
 - The responsibility for performance to this specification shall not be divided among individual component manufacturers, but must be assumed solely by the primary manufacturer. This includes generating system design, manufacture, test, and having a local supplier responsible for service, parts, and warranty for the total system.
- SUBASSEMBLY AND PACKAGING
 - Generator set mounted subassemblies such as cooling system, base, air intake system, exhaust outlet fittings, and generator set mounted controls and switchgear shall also be designed, built, and assembled as a complete unit by the engine - generator manufacturer.
- PRODUCTION TESTS
 - The system manufacturer shall perform postproduction tests on the generator set supplied. A certified report of these tests shall be available when requested at the time of the generator set order.
- DRAWINGS/SCHEMATICS
 - All installation drawings and wiring diagrams for the generator set, controls, and switchgear must conform to a common format of 8 ½" x 11", 11" x 17" and 24" x 36".
- SUBMITTALS
 - Submittals shall include but not be limited to:
 - Component List - A breakdown of all components and options including switchgear.
 - Technical Data - Manufacturer produced generator set specification or data sheet identifying make and model of engine and generator, and including relevant component design and performance data.
 - Engine:
 - Type, aspiration, compression ratio, and combustion cycle. Bore, stroke, displacement, and number of cylinders.
 - Engine lubricating oil capacity.
 - Engine coolant capacity without radiator. Engine coolant capacity with radiator.
 - Coolant pump external resistance (maximum). Where remote radiator is specified
 - Generator: Model
 - Model
 - Frame
 - Insulation class
 - Number of Leads
 - Weight, total
 - Weight, rotor
 - Air Flow
 - At rated voltage:
 - Efficiency at 0.8 power factor for: 50% load, 75% load, 100% load
 - Fault current, 3 phase symmetrical
 - Decrement curve
 - Radiator: (High Ambient, Brass)
 - Model

- Type
 - Coolant capacity, radiator
 - Coolant capacity, radiator and engine
 - Weight: Dry, Wet
- System:
 - Dimensions: Length, Width, Height
 - Weight: Dry, Wet
- Performance in 115°F air, 2400 MSL.
 - Continuous power rating at 0.8 power factor (KW) kVA rating
 - Fuel consumption at standard conditions for:
 - 50%, 75% and 100% load Heat rejection to:
 - coolant, after-cooler, exhaust, atmosphere from engine, and atmosphere from generator
 - Exhaust gas stack temperature
 - Exhaust gas components; % NOX, % SO
 - Tons particulate/yr/mo at 50%, 100% load
 - Verification of 10% overload capability
- Transient response of frequency and voltage for the generator set:
- Auxiliary Equipment - Specification or data sheets, including switchgear, spring type vibration isolators.
- Drawings - General dimensions drawings showing overall generator set measurements, mounting location, and interconnect points for load leads, fuel, exhaust, cooling and drain lines.
- Wiring Diagrams - Wiring diagrams, schematics and control panel outline drawings published by the manufacturer in Joint Industrial Council (JIC) format for controls and switchgear showing interconnected points and logic diagrams for use by contractor and owner.
- Warranty Statements - Warranty verification published by the manufacturer.
- Service - Location and description of supplier's parts and service facility including parts inventory and number of qualified generator set service personnel.
- SERVICE AND WARRANTY
 - The manufacturer shall have a local authorized dealer who can provide factory trained servicemen, the required stock of replacement parts, technical assistance, and warranty administration.
 - The manufacturer's authorized dealer shall have a parts and service facility within 130 miles of the jobsite.
 - The generator set supplier shall have factory trained service representatives and tooling necessary to install, test, maintain, and repair all provided equipment.
- WARRANTY ADMINISTRATION
 - The manufacturer's authorized dealer shall be capable of administering the manufacturer and dealer's warranty for all components supplied by the selling dealer (who may or may not be the same as the servicing dealer).
- WARRANTY TERMS
 - The manufacturer's and dealers standard warranty shall in no event be for a period of less than two (2) years

from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing dealer. Submittals received without written warranties as specified will be rejected in their entirety.

- The manufacturer's and dealers extended warranty shall in no event be for a period of less than five (5) years from date of initial start-up of the system or 2500 operating hours, whichever comes first. It shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Applicable deductible costs shall be specified in the manufacturer's warranty. Submittals received without written warranties as specified will be rejected in their entirety.
- WARRANTY NAMEPLATE
 - A warranty nameplate of not less than 152 mm x 203 mm (6 in x 8 in) must be affixed to the generator set with the following data:
 - Warranty Period:
 - Start-up Date:
 - Termination Date:
 - Supplier Name:
 - Supplier Address:
 - 24-Hour Emergency Number:
 - Preventive maintenance to be performed by:
- MAINTENANCE CONTRACT
 - The generator set supplier shall offer a maintenance and repair contract that guarantees all support costs of the specified system. It shall include routine and 24-hour emergency access to a factory account manager to expedite emergency repairs. This shall be priced during the bid process as an additive bid item.
 - The contract shall protect the user from parts and labor price increases, and shall provide a refund of residual funds at any time of user dissatisfaction. Optional payment schedules shall include fixed rate throughout the life of the contract.
- PARTS AVAILABILITY
 - The generator set supplier shall have sufficient parts inventory to maintain over the counter availability of at least 90% of any normal wear and tear parts. (Belts, hoses, filters, turbines, pumps, safeties, regulators, injectors, gaskets)
 - The generator set supplier shall guarantee overnight 100% parts from the time an order is entered with the dealer.
- OIL SAMPLING SERVICE
 - The generator set supplier shall provide a scheduled oil sampling service to monitor engine condition on an ongoing basis. The sampling method shall be of the atomic absorption spectrophotometry method.
 - Immediate notification of critical results shall be provided to the owner's representative.

- The following articles and paragraphs are intended to define a power generation system of proven type and design, of current production, and with all components commercially available.
- Approved systems, subject to conforming to the Specifications are Caterpillar, Generac and Cummins/Onan.
- These products shall be from vendors with factory approval as stocking dealer – distributors with evidence of having supplied and serviced units of equal size and performance for at least 5 years.
- Generators shall be designed to provide not less than 110% output, based on specified capacity, for a period of 2 hours at temperature extremes.
- ENGINE
 - The engine shall be a stationary, liquid cooled, 1800 rpm, four-cycle design, vertical inline or V- type, with Dry exhaust manifolds. It shall have cylinders with minimum displacement of xx liters and be manufactured in the United States.
- ENGINE EQUIPMENT
 - The engine shall be equipped with air filters, fuel filters and pressure gauge, lubricating oil cooler, filters, and pressure gauge, water pump and temperature gauge, service hour meter, flywheel, and flywheel housing.
- LUBRICATION SYSTEM
 - The lubrication oil pump shall be a positive displacement type that is integral with the engine and gear driven from the engine gear train. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.
 - The bypass valve must be integral with the engine filter base or receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.
 - System shall utilize synthetic lubricants with compatible filtration, and compatible engine seals, approved by the engine manufacturer.
- GASEOUS FUEL SYSTEM
 - The gaseous fuel system shall consist of gas pressure regulators and carburetors. The carburetor shall be a diaphragm type that includes a load screw for air-fuel ratio adjustment, and throttle body to control the air-fuel mixture to the engine.
- IGNITION SYSTEM
 - The ignition system shall be the low-tension type and consist of magneto, transformers, and spark plugs. The magneto shall be of solid-state design and spark plugs will incorporate gold palladium electrodes for reliability and life.
- GOVERNOR
 - The engine governor shall control engine speed and transient load response within commercial and ISO 8528 tolerances. It will be selected, installed, and tested by the generator set manufacturer.
- GOVERNOR, ELECTRONIC-SPEED CONTROL

- The engine governor shall be a Woodward 2301 Electronic Speed Control with EG Electro- Hydraulic Actuator or Barber Coleman Equal. Speed drop shall be externally adjustable from 0 (isochronous) to 10% from no load to full rated load. Steady state frequency regulation shall be ± 0.25 percent.
- COOLING SYSTEM
 - The engine jacket water cooling system shall be a closed circuit design with provision for filling, expansion, and de-aeration. The engine shall drive the cooling pump. Auxiliary coolant pumps required for heat exchangers or separate circuit after cooling shall also be engine driven. Coolant temperature shall be internally regulated to disconnect external cooling systems until operating temperature is achieved.
- RADIATOR, ENGINE-MOUNTED
 - Heat rejected to the engine jacket water shall be discharged to the atmosphere through a close-coupled radiator. The radiator shall be sized to cool the engine continuously while operating at full rated load and at site conditions of 115°F ambient.
- FAN AND BELT GUARDING
 - The fan, fan drive, and fan belts shall be covered with punched steel mesh guarding for personnel protection. The guarding shall conform to UL 2200.
- BLOWERFAN
 - The radiator-cooling fan shall be a blower type driven from the engine. Air shall be drawn from the engine side and exhausted through the radiator core with no more than 12.7 mm (0.5 in) of water external restriction in addition to core restrictions.
- INLET AIR SYSTEM
 - The engine air cleaner shall be engine mounted with dry element requiring replacement no more frequently than 250 operating hours or once each year.
- TURBOCHARGING
 - Only single stage turbo charging shall be allowed.
- AFTERCOOLING
 - After-cooler core air surfaces shall be coated with a corrosion inhibitor to minimize oxidation.
- EXHAUST SYSTEM
 - The engine exhaust system shall be installed to discharge combustion gases quickly and silently with minimum restriction. System including silencer shall be designed for minimum restriction, and in no case shall backpressure exceed 6.7 kPa.
 - Heavy walled piping such as Schedule 40 is preferred, with radii of 90 bends at least 1-1/2 times the pipe diameter. Piping shall be installed with 229 mm (9 in) minimum clearance from combustible material or incorporate appropriate insulation and shielding.
 - Piping shall be supported and braced to prevent weight or thermal growth being transferred to the engine and flexible expansion fittings provided to accommodate thermal growth. Support dampers and springs shall be

included where necessary to isolate vibration. Install in accord with manufacturer's recommendations.

- Long runs of pipe shall be pitched away from the engine and water traps installed at the lowest point. Exhaust stacks shall be extended to avoid nuisance fumes and odors and outlets cut at 45° to minimize noise. Aim outlet to northwest as directed.
- SILENCER-CRITICAL
 - Provide critical silencer in accordance with Paragraph 2.32 E.
 - The silencer shall have an end inlet and end outlet.
- PACKAGED SYSTEMS
 - Submit for individual approval in lieu of Paragraph 2.16.
- ELECTRIC STARTING SYSTEM
 - The engine starting system shall include 24 volt DC starting motor(s), starter relay, and automatic reset circuit breaker to protect against butt engagement. Batteries shall be maintenance free, lead acid type mounted near the starting motor. A corrosion resistant or coated steel battery rack shall be provided for mounting. Required cables will be furnished and sized to satisfy circuit requirements. The system shall be capable of starting engine within 10 seconds. 12 v systems will be considered for 75 kw or less units by prior approval.
- JACKET WATER HEATER
 - Jacket water heater(s) shall be provided to maintain coolant temperature of 32 C (90 F) while the engine is idle. Heaters shall accept 208-volt AC single-phase power and include adjustable thermostats.
- BATTERIES
 - Batteries for starting and control shall be selected and supplied by the generator set manufacturer. They shall be a heavy-duty SLI lead acid type with through-partition connectors, and housed in a hard rubber or polypropylene case with provision for venting.
 - Battery warranty shall be the responsibility of the generator set manufacturer.
- ALTERNATOR
 - An engine mounted belt driven battery charging alternator shall be installed with an automatic voltage regulator. It shall be suitable for heavy-duty applications with a rating of 24 volts.
- INSTRUMENTATION-ENGINE
 - The engine-mounted instrument panel shall consist of a shock-mounted formed and welded enclosure primed for coastal environment. Provide Metric/English marked gauges. Gauges shall include engine oil pressure, oil filter differential, fuel pressure, jacket water temperature, electric service meter and running time meter.
- GENERATOR
 - The generator shall be equivalent to caterpillar model xxx and shall be rated for standby service at xxx kw, xxx KVA, 0.8 PF, xxx V, three phase, wire, 60 Hz, 1800 rpm.

- The generator shall be capable of withstanding a three phase load of 300% rated current for 10 seconds, and sustaining 150% of continuous load current for 2 minutes with field set for normal rated load excitation.
- It shall exhibit less than 5% waveform deviation at no load.
- Generator efficiencies shall be calculated according to IEC 34-2 Section 4, with all current squared times R losses corrected to 115 F.
- STRUCTURE
 - The generator shall be close coupled, drip proof and guarded, constructed to NEMA I and IP 22 standards, single bearing, salient pole, revolving field, synchronous type with amortisseur windings in the pole faces of the rotating field.
- MECHANICAL DESIGN - SINGLE BEARING
 - The generator housing shall be one piece and mount directly to the engine flywheel housing without bolted adaptors.
- WINDINGS
 - Thermal Class 200 magnet wire as described by NEMA Magnet Wire Standard MW 1000, Section MW 35-C, shall be used for rotor and stator windings. The windings shall consist of copper magnet wire. All winding insulation materials shall be Class H in accordance with BS and IEEE standards.
- OPERATING ENVIRONMENT
 - The generator shall be designed to operate in a sheltered drip-proof environment.
- EXCITER-PERMANENT MAGNET
 - The permanent magnet excitation system shall derive excitation current from a pilot exciter mounted on the rotor shaft. It shall enable the generator to sustain 300% of rated current for ten seconds during a fault condition.
- VOLTAGE REGULATOR - SEALED
 - The manufacturer of the engine-generator set shall manufacture the automatic voltage regulator. The volts/hertz regulator shall sense line-to-line three phases of generator output voltage and exhibit the following characteristics:
 - Generator output voltage maintained within +/- 1% of rated value for any load variation between no load variation between no load and full load.
 - Generator output voltage drift no more than +/- 1/2% of rated value at constant temperature.
 - Generator output voltage drift no more than +/- 1% of rated value within a 40° change over ambient temperature range of -40° C to 70° C.
 - Generator frequency change not over ¼ cycle no load to full load and back.
 - Response time less than 20 milliseconds.
 - Telephone Influence Factor (TIF) of less than 50.
 - Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.
 - The regulator shall include the following features:
 - Voltage level rheostat to provide generator output voltage adjustment of -25% to +10% of nominal.
 - Gain adjustment to provide output voltage compensation for changes in load or frequency.

- MOUNTING BASE-STANDBY PACKAGE
 - The base shall be constructed of formed "C" section steel members with minimum 6 mm thickness. Corners shall be squared to provide rodent/bird proof joint when enclosure is added. Provision shall be made for four corner lifting. It shall incorporate flexible fuel lines, external oil and coolant drains and external crankcase fumes disposal hose. Support cross members shall add rigidity and allow installation of vibration isolators between base and generator set. Generous space for ground stub-ups between the members shall be provided. The base shall include bottom-mounting holes.
- ISOLATOR-SPRING TYPE
 - Steel spring isolators shall be installed between the generator set base and the mounting surface. The isolators shall bolt to the base, and have a waffled or ribbed pad on their bottom surface. The pads shall be resistant to heat and age, and impervious to oil, water, antifreeze, diesel fuel, and cleaning compounds
- ENCLOSURE - STANDBY PACKAGE, FULL
 - The enclosure shall offer protection as specified by OSHA from all moving and hot parts of the engine, generator and radiator. It shall be constructed to allow full access to the engine for maintenance without exposing personnel to any moving machinery. Radiator and radiator fan assembly shall be totally enclosed with lockable door over the radiator cap. The radiator shall be sized to accommodate any resulting air flow restrictions. Provision shall be made for a duct flange or perforated metal grill to protect the radiator core. Doors shall be the lift off hingeless type with lockable stainless steel security latches.
 - Louvers shall allow sufficient airflow to allow full load operation of the generator set. The louvers shall be twisted to deflect water and direct noise downward. The enclosure shall satisfy IEC 1P22 requirements for drip proof construction acceptable for outside installation when doors are in place.
 - The enclosure shall be fitted to the generator set base and isolated from engine vibration. Corners shall be formed and welded to assure strength and rigidity. Sheet metal with minimum thickness of 2.0 mm for enclosure and 1.2 mm for doors shall have no burrs or sharp edges. Inside and outside surfaces shall be finished with a baked high performance enamel. Exposed fasteners shall be minimized with all hardware stainless steel.
 - Outdoor generator enclosures shall be sage green, Federal standard 595b, 14449.
- CONTROLS, PROTECTION AND MONITORING
 - The controls, protection and monitoring systems of the generator set and its operation shall be the responsibility of the generator set manufacturer. All subsystem components, interfaces, and logic shall be compatible with engine-mounted devices.
- AUTOMATIC START-STOP CONTROL
 - The control panel shall be shock mounted on the generator and have the capability to face either side or the rear of the generator. The 24-volt DC system shall incorporate energize to run logic and include:
 - Control:
 - Generator voltage level rheostat and ammeter/voltmeter phase selector switch shall be mounted on the panel door.
 - The engine start-stop switch shall be door mounted, include positions for off/reset, manual, automatic, and stop.

- Shutdowns/Annunciation:
 - The generator set shall shut down and individual red lights shall signal operational faults of high water temperature, low oil pressure, overspeed and overcrank.
- Monitor:
 - Monitoring devices shall include AC voltmeter, AC ammeter, ammeter/voltmeter phase select switch, frequency meter, electric hour meter, oil pressure gauge, and water temperature gauge.
- Safety Devices:
 - ISO red emergency stop pushbutton shall be provided, and all controls, annunciation, and monitors labeled with ISO symbols.
- Cycle Cranking
 - A cycle crank timer shall provide five 10 second cranking periods separated by 10 second rest periods.
- Engine Cool Down
 - A cool down timer shall provide an adjustable 0-30 minute engine-running period before shutdown after removal of load set at 15 min.
- Alarm Module
 - NFPA-99 requirements for the alarm panel shall be satisfied by a 24 volt DC alarm module mounted in the panel and including red indicating lights and silence able alarm horn to annunciate alarm conditions for high and low coolant temperature, low oil pressure, low DC voltage, and system not in automatic.
- Battery Charger
 - The battery charger is to be a solid-state device with adjustable float voltage control. It is to be a constant voltage device with current limit, and it is to include an equalize switch which will allow the battery to be overcharged for maintenance purposes.
- Overvoltage, Undervoltage and Underfrequency Protection
 - The controls will include devices to protect against overvoltage, undervoltage, underfrequency and overfrequency output from the generator. This protection must sense voltage and frequency directly and controls which attempt to measure these values by measuring excitation current will not be acceptable.
- Emergency Stop Switch
 - The engine controls will be arranged to stop the engine if a remote maintained contact emergency stop switch is depressed. Once the switch has been operated, it should not be possible to start the engine until the stop switch is released. The "Switch off Normal" indicating lamp on the front of the panel and the remote engine fail alarm must both be activated if the stop switch has been operated.
- CIRCUIT BREAKER-GENERATOR SET MOUNTED
 - The circuit breaker shall be mounted and connected in a guarded drip-proof enclosure. Cable lugs shall be provided for customer connections.
 - One molded case electronic circuit breaker, three pole, and single-throw, stationary-mounted with manual operating handle, overload and short circuit trips, complete with cable lugs. Overcurrent trip shall be 100% rated and sized to provide enclosed and ambient temperature compensation. The breaker shall be qualified for 600-volt operation and tested in accordance with UL Standard 489, LSI / LSIG. Breaker shall be adjustable to allow for 110% output test.
 - One shunt trip, 24 volt DC, on circuit breaker wired to terminal board.
 - Three current transformers, 5-ampere secondaries.
 - One ground connection point.
- REMOTE ANNUNCIATOR PANEL

- NFPA-99 requirements for remote annunciation shall be satisfied by a remote mounted electro- mechanical panel which includes red and yellow indicating lights and silenceable alarm horn for low oil pressure shutdown, low coolant temperature alarm, high coolant temperature, shutdown, overcrank, overspeed shutdown, battery charger malfunction (via charger switch), generator on load (via Customer switch). Install where directed by the College.
- AUTOMATIC TRANSFER SWITCH
 - The automatic transfer switch shall be as specified in the specification.
- WEATHERPROOF SOUND ATTENUATING ENCLOSURE
 - Enclosure shall be sound attenuating enclosure: the engine-generator set shall be factory enclosed in not less than a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be coated with electrostatically applied paint, baked and finished to manufacturers specifications. The enclosure shall be completely lined with not less than 1" thick, UL 94 HF-1 listed, sound deadening material. This material must be of a self extinguishing design. The critical silencer shall be included to further reduce the unit sound level. The overall design must be such that sound level is 75dbA at 7 meters (23 feet) or less.
 - Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be of critical grade to attenuate the sound to the level noted above. It shall be supplied with a flexible, seamless, stainless steel exhaust connection. A rain cap will be supplied to terminate the exhaust pipe. These components must be properly sized to assure operation without excessive backpressure when installed.

Part 3- Execution

- The following articles and paragraphs are intended to define acceptable procedures and practices of inspecting, installing, and testing the generator set and associated equipment.
- PREDELIVERY INSPECTION
 - The system manufacturers' local dealer at the dealer's facility to insure no damage occurred in transit and all genset components, controls, and switchgear are included as specified herein must perform a pre-delivery inspection.
- PREDELIVERY TESTING
 - Prior to delivery and acceptance, the generator set shall be tested to show it is free of any defects and will start automatically and carry full load. This testing shall be performed at the facility of the system manufacturer's authorized local dealer.
 - The testing shall be done on dry type, resistive load banks.
 - The load banks shall not be dependent on the generator control instruments to read amperage and voltage on each phase. Rather, the test instrumentation will serve as a check of the generator set meters.
 - Load bank testing shall be done in the presence of the owner's engineer or his appointed representative. After manufacturers approved break-in procedure, sample oil, change oil and performance testing, forward oil test results to PCC Project Manager. Testing shall be for a minimum of 1 hour at 80% load, 1 hr. at 100% load, 2 hrs. at 110% load, 1.0 pf. Demonstrate voltage dips and frequency dips with block loading. If breaker trips, record time run at 110°

- The bidder shall furnish all consumables necessary for testing. Any defects that become evident during the test shall be corrected by the bidder at his own expense prior to shipment to the jobsite.
- SHIPMENT TO JOBSITE
 - Delivery shall be FOB to the jobsite by the system manufacturer's authorized dealer.
- INSTALLATION
 - The installation shall be performed in accordance with shop drawings, specifications, and the manufacturer's instructions.
- FIELD QUALITY CONTROL
 - A representative of the system manufacturer's authorized local dealer shall check the complete installation for procedural and operational compliance. The generator set dealer shall provide the engine lubricating oil and antifreeze, as recommended by the system manufacturer. If different manufacturers furnish switchgear and generator sets, technical representatives of both manufacturers' authorized dealers shall verify the installation meets requirements. Any deficiencies shall be noted and corrected by the Contractor.
 - The system manufacturer's dealer representative shall be present to assist the Contractor during start-up, systems check, adjusting, and site testing required after the installation is complete. Re run the pre delivery test and then test the oil. (Do not change the oil.)
- POST-INSTALLATION TESTING
 - Following installation, the system manufacturer's local dealer representative in the presence of the owner's engineer or designated appointee shall perform the following tests.
- PRESTART CHECKS
 - Oil level
 - Water level
 - Day tank fuel level
 - Battery connection and charge condition
 - Air start supply pressure (if so equipped)
 - Engine to control interconnects
 - Engine generator intake/exhaust obstructions
 - Removal of all packing materials
- OPERATION
 - Load - two hours operation at 80% of full load rating. One-hour operation at 100% of full load rating and one hour at 110°C. After the first half-hour stabilization period at full load, the following shall be recorded at fifteen minute intervals (starting at time equals "zero"):

- Voltage, amperage, frequency
- Fuel pressure, oil pressure and water temperature
- Exhaust gas temperature at engine exhaust outlet
- Ambient temperature

- If equipped with appropriate instrumentation:
 - Kilowatts
 - Power Factor
 - KVARs
 - Generator Temperature

- Proper operation of controls, engine shutdown, and safety devices shall be demonstrated.

- ORIENTATION
 - The system manufacturer's authorized dealer shall provide a complete orientation for the owner's engineering and maintenance personnel. Orientation shall include both classroom and hands-on instruction. Topics covered shall include control operation, schematics, wiring and diagrams, meters, indicators, warning lights, shutdown system and routine maintenance.

- SERVICE MANUALS AND PARTS BOOKS
 - The system manufacturer's authorized local dealer shall furnish one copy each of the manuals and books listed below for each unit under this contract:
 - OPERATING INSTRUCTIONS - with description and illustration of all switchgear controls and indicators and engine and generator controls.
 - PARTS BOOKS - that illustrate and list all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).
 - PREVENTATIVE MAINTENANCE INSTRUCTIONS - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.
 - ROUTINE TEST PROCEDURES - for all electronic and electrical circuits and for the main AC generator.
 - TROUBLESHOOTING CHART - covering the complete generator set showing description of trouble, probable cause and suggested remedy.
 - RECOMMENDED SPARE PARTS LIST - showing all consumables anticipated to be required during routine maintenance and test.
 - WIRING DIAGRAMS AND SCHEMATICS - showing function of all electrical components.

 - All manuals and books described above shall be contained in rigid plastic pouches.

- CONTRACT MAINTENANCE
 - The system manufacturer's authorized dealer shall furnish the owner's engineer with a copy of any contract maintenance agreement negotiated relative to the equipment specified in this section. The contract information shall detail agreed maintenance intervals, work to be performed at each interval, reimbursement schedule for maintenance work, and owner's responsibilities versus dealer's responsibilities.

End of Section 26 32 13.16

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Section 26 33 53 – Static Uninterruptible Power Supply

Introduction

The design of UPS systems is normally associated only with specialized computer room distribution systems. At the present most of these systems are not associated with the renovation of any building or facility, but rather a piece of equipment that would be provided by the user as a separate item. However where they are to be provided by the contractor as a part of the construction package the following guidelines should be taken into account for the design.

- A minimum of a 20-minute battery backup shall be used.
- Only static UPS units should be used.
- Design should provide for a minimum of 30% spare capacity.
- Design shall be based on top quality static UPS systems such as those supplied by Liebert, and similar manufacturers.
- Design for the electric service to the unit should take into account the losses for the system.
- Since these units generate a large amount of heat and are usually somewhat noisy it is recommended that they be located in a room where the general public will not normally be working, where there is adequate air conditioning for the required heat load, and where the walls provide a good deal of noise attenuation.
- The UPS room or area shall be engineered so that the UPS will operate in its environment without overheating. Cool as necessary.
- Equipment shall be front access only.
- Transformerless UPS systems should be considered.

Should this section be required for an actual project please consult with the Pima Facilities Operations.

Part 1 - General

- All systems must be UL listed.
- Provide complete submittals on UPS system including operations and maintenance manuals (minimum of 4 copies).
- Provide for two years of preventative maintenance as a part of the cost of the UPS.
- Specify seismic anchoring of all UPS cabinets. Provide remote status monitoring for all systems.
- Provide external bypass panel.
- Provide monitor panels for unattended UPS units. Connect to a location satisfactory to the PCC Facilities Operations.

Part 2 - Products

- To be determined at time of design. Suggested manufacturers to be Liebert or approved equal.

Part 3 - Execution

- Install units in an area where they are fully accessible for maintenance, and with adequate ventilation.

End of Section 26 33 53

DIVISION 26 - ELECTRICAL

Section 26 35 23 – Electromagnetic-Interference Filters

Introduction

Electromagnetic shielding is only required when due to the type of testing going on in a building that high levels of electromagnetic fields (EMF) are generated in an area. Typically, if personnel are being exposed to levels of EMF higher than 100 mg then electromagnetic shielding should be provided or special consideration should be taken to lower the EMF.

Sometimes it will be necessary to build a specially shielded room for personnel involved in the testing of special systems to minimize the amount of EMF and RF (radio frequencies) which would enter the test space.

Only personnel who are experienced in design of shielded rooms or special shielding facilities shall do the design of such a system in either case. Special grounding systems shall be taken into account to facilitate complete draining of all EMF energies into the ground and thus protect personnel.

Part 1 - General

- Provide complete submittals for the design whether by the engineering firm or a design build concept is used.

Part 2 - Products

- All grounding parts shall be copper. Copper shielding shall be utilized in the design. Where required for personnel protection the entire system shall be UL certified.

Part 3 - Execution

- Personnel experienced in the construction of Electromagnetic shielding systems shall only accomplish the installation of the system. Following the construction of the system, it shall be the requirement of the installer to have the entire system tested to verify that it complies with the minimum design constraints set up prior to the design of the system.
- Foil systems utilizing foil stapled to walls is unacceptable design.
- Consult Project Manager for test/compliance of these facilities during design.

End of Section 26 35 23

DIVISION 26 - ELECTRICAL

Section 26 36 23 Automatic Transfer Switches

Introduction

The intent of this section is to require that at each location where an emergency generator system is utilized an automatic transfer switch (ATS) or bypass isolation transfer switch shall be utilized.

Since more and more equipment is being added to the system that is "protected" by the emergency generator system it is important that a top quality transfer switch be utilized. In addition, it has been found that though many of the manufacturers of emergency generators can provide a switch in conjunction with the emergency generator that these are usually of a lower overall quality and more subject to breakdown. Therefore, we would suggest that the ATS be of similar quality to that in the accompanying specification.

The ATS should be sized to meet both the maximum short circuit current available from the combined sources (in case of a direct fault during transfer), and for 125% of the available current from either the normal or emergency power source with a 3 cycle rating in excess of UL 1008.

Since the ATS generally contains electronic items make sure that the location of the transfer switch is compatible (i.e. adequate cooling and minimum dust) with the transfer switch.

Whenever GFI is used, provide 4 pole switches.

Transfer switch shall have programmable auto exercising feature for once a week.

Part 1 - General

- Complete submittals and operational manuals shall be provided as a part of the system.
- The warranty shall be the same as that of the emergency generator that it is associated with.
- Complete maintenance manuals and spare parts lists be provided as a part of the project close out documents.
- One 600 Amp, 3 Phase, 480 Volt Automatic Transfer Switch (ATS) shall be provided with gasketed enclosure. The ATS shall consist of an inherently double throw power transfer switch unit and a control module interconnected to provide complete automatic operation. The operating transfer time* in either direction shall not exceed one-sixth (1/6) of a second.
- Required capacity, (Refer to Contract Drawings), 3 Phase, 480 Volt Isolation Bypass Automatic Transfer Switch (ATS) shall be provided with enclosure. The ATS shall consist of an inherently double throw power transfer switch unit and a control module interconnected to provide complete automatic operation. The operating transfer time* in either direction shall not exceed one-sixth (1/6) of a second.

Part 2 - Products

- Russelectric, or prior approved equal. Zenith and ASCO may be specified after first documenting proof of third party testing for a 3-cycle rating. (Prior to completing contract documents submit proof at design development stage of design).
- The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized to minimize power consumption and heat generation. The switch shall be positively locked and unaffected by voltage variations or momentary outages so that contact

pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life. The switch shall be mechanically interlocked to ensure only one of two possible positions – normal or emergency.

- All main contacts shall be silver composition.
- Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operation handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.
- A control module shall direct the operation of the transfer switch. The module's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance and inherent digital communications capability. The control module shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control module to be disconnected from the transfer switch for routine maintenance.
 - The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE standard 472-1974 (ANSI C37, 90a-1974) and the impulse withstand voltage test in accordance with the proposed NEMA Standard ICS 1-109.
- Operation:
 - The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85 to 100% and dropout adjustable from 75 to 98% of pickup setting, both in increments of 1%, and shall be fully field-adjustable without the use of any tools, meters or power supplies. Repetitive accuracy of settings shall be +/- 2% or better over an operating temperature range of -20C to -70C. Factory set to pick up at 90% voltage and 95% frequency.
 - The control module shall include four time delays that are fully adjustable over the entire range as follows:
 - Time delay to override momentary normal source outages to delay all transfer switch and engine starting signals. Adjustable from 0 to 6 seconds. Factory set at 1 second.
 - Transfer to emergency time delay. Adjustable from 0 to 5 minutes. Factory set at 0 minutes unless indicated otherwise on the plans.
 - Retransfer to normal time delay. Time delay is automatically bypassed if emergency source fails and normal source is acceptable. Adjustable from 0 to 30 minutes. Factory set at 10 minutes.
 - Unload running item delay for emergency engine generator cool down. Adjustable from 0 to 60 minutes. Factory set at 15 minutes.
 - Exercising and cool down clocks.
 - All standard features commonly shown in manufacturer's literature.
 - A set of DPDT gold-flashed contacts rated 10 Amps, 48 VDC shall be provided for a low-voltage engine start signal when the normal source fails. The start signal shall prevent dry cranking of the generator by requiring the generator to reach proper output and to run for the duration of the cool down setting regardless of whether the normal source restores before the load is transferred. Also, provide a "commit/no commit to transfer" selector switch to select whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
 - A momentary-type test switch shall be provided to simulate a normal source failure. Also, terminals for a remote contact which opens to signal the ATS to transfer to emergency and terminals for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal shall be provided.

- Output terminals to signal the actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source, shall be provided.
- One set of auxiliary contacts shall be provided rated 10 Amps, 480 VAC consisting of one contact closed when the ATS is connected to normal and 1 contact closed when the ATS is connected to emergency. Also, one set of signal lights to indicated when the ATS is connected to normal source and when the ATS is connected to emergency source shall be provided.
- See attached sheet 6 figure #1 for maximum allowable dimensions of ATS without enclosure.
- For each switch provide:
 - Trouble shooting hints.
 - O & M manual.
 - Complete ladder schematic.
 - Wiring diagram.
 - Parts list.
 - Switching Monitor: Manufacturer shall provide one of the following:
 - Inphase Monitor:

An inphase monitor shall be built-in to the ATS and shall control transfer so that motor load inrush currents do not exceed normal starting currents to avoid nuisance tripping of circuit breakers and possible mechanical damage to motor couplings. The inphase monitor shall operate without external control of electrical loads and without any external control of the power sources. The monitor shall compare the phase relationship and frequency difference between the normal and emergency sources and permit transfer can be accomplished within 60 electrical degrees as determined by monitoring the frequency difference. Inphase transfer shall be accomplished if the sources are within 2 Hz of nominal frequency and 70% or more of nominal voltage.

System shall have the ability to be manually switched to a mode that drops the load long enough to allow motor decay and reenergize on the alternate source. This is where the two sources are utilities, or sourced from the same utility.
 - Programmed Monitor:

Monitor shall detect motor decay and provide delayed open transition switching where in phase monitors are provided as part of the software. Provide PCC with codes to activate and deactivate.
- Code Compliance:
 - The ATS shall conform to the requirements of:
 - 3 cycle rating in excess of UL 1008 – Standard for Automatic Transfer Switches. (Fully rated.)
 - UL 1008 – Standard for Automatic Transfer Switches. Optional 3 cycle testing.
 - NFPA 70 – National Electrical Code including use in emergency and standby systems in accordance with Articles 571, 700, 701 and 702.
 - NFPA 99 – Essential Electrical Systems for Health Care Facilities.
 - NFPA 110 – Standard for Emergency and Standby Power Systems.
 - IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book).
 - IEEE Standard 241 – IEEE Recommended Practice for Electric Power Systems in commercial buildings (Gray Book).
 - NEMA Standard ICS – 2-447 – AC Automatic Transfer Switches.
 - IEC – Standard for Automatic Transfer Switches.
 - The ATS shall be UL listed in accordance with UL 1008 as follows:
 - Rated in amperes for total system transfer including control of motors, electric- discharge

lamps, electric heating and tungsten-filament lamp loads as referred to in Paragraph 38.13 of UL 1008.

- Overload and endurance at 480 Volts AC per tables 25.1, 25.2, 27.1 and 27.2 of UL 1008 when enclosed according to Paragraph 1.6.
- Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits.
- No welding of contacts. Transfer switch must be electrically operable to alternate source after they withstand current tests.
- Dielectric tests at 1960 Volts, RMS, minimum after they withstand current tests.
- Additional optional testing for 3-cycle compliance.
- The ATS shall be “fully” rated to withstand the RMS symmetrical short circuit current available at the ATS terminals for 3 full cycles, verified by oscillograph testing by an independent test agency, in EXCESS of UL 1008, without series protection of fuses or circuit breakers.

Part 3 - Execution

- All production units shall be subjected to the following factory tests:
 - The complete ATS shall be tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
 - The switch shall be subjected to a dielectric strength test per NEMA Standard ICS 1- 109.21.
 - Fire Alarm System and report to the PCC Environmental Health & Safety Department must monitor ATS.
- The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand current ratings. The certification shall identify by serial number(s) the equipment involved. No exceptions to the specifications other than those stipulated at the time of submittal shall be included in the certification.
- Manufacturer
 - The ATS manufacturer shall maintain a local service center capable of emergency service or routine preventative maintenance contracts. The manufacturer shall maintain records of each switch by serial number for minimum of 20 years.
 - The ATS manufacturer shall provide same day emergency parts available to customer.
 - Whenever the words “AS MAY BE DIRECTED”, “SUITABLE”, “OR EQUIVALENT”, “AS APPROVED”, or other words of similar intent and meaning are used implying that judgment, discretion, or decision is to be exercised, it is understood that it is the judgment, discretion, or decision of the Owner to which the reference is made. All materials and articles necessary for the work are subject to the approval of the Owner.
 - Decision of the Owner to which the reference is made. All materials and articles necessary for the work are subject to the approval of the Owner.
 - Startup and check out to be by a manufacturer's certified technician.
 - The following manufacturers are approved, subject to approval, based on conformance to this specification:
 - Russelectric Bypass Isolation Switch.
 - Zenith Bypass Isolation Switch

- Others: By prior approval submittal. 3 cycle testing in excess of UL 1008 is required prior to the submittal.

End of Section 26 36 23

**Operating transfer time is the time measured from instant of monitored source deviation to closing of main contacts on an available alternate power source exclusive of any purposefully introduced time delay.*

DIVISION 26 - ELECTRICAL

Section 26 43 00 - Surge (Overcurrent) Protective Devices

Introduction

The general philosophy regarding the application of protective devices is that the circuit breaker or fuse at the source must be sized to protect the wiring. The motor protective device (overloads on a motor starter) should be sized to protect the motor (except where permitted under other sections of the NEC). Where a combination motor starter is used, it is preferred that a fused disconnect be utilized rather than motor circuit protectors. (Both for single units and motor control centers).

Wiring should be always sized to be adequate to serve the load served. The maximum rating of the protective device upstream of the wiring should never be higher than the 75°C column of Table 310-16 of the NEC or as appropriate for the actual equipment being utilized.

The AIC rating of the protective device must be adequate for the available short circuit of the devices being used. Therefore it is imperative that with each design where the primary distribution to a building is being modified that a proper short circuit calculation be made and applied to the design. Where the short circuit rating of downstream devices is not adequate for the available short circuit current then either the downstream devices must be replaced with higher AIC rated devices or current limiting devices must be used.

The load analysis for the building should be calculated each time a modification to the building loading is done so that a general building overload or a feeder circuit overload will not occur due to inattention to this detail. Should the new loads introduce a situation which would cause either a building or a feeder overload then the Engineer should discuss the situation with the Pima Facilities Operations.

On new facilities, all circuit breakers from the main to the 120/208 volt panelboards shall be coordinated and a copy of the coordination study provided to the Pima Facilities Operations during the construction of the facility but prior to ordering any electrical gear

Part 1 - General

- Circuit breakers shall be of the same manufacturer as that of the panelboard or switchboard in which it is manufactured.
- For new equipment, circuit breakers shall be either GE, Cutler Hammer, Siemens, or prior approved equal.
- Fuses shall be as manufactured by BUSS, Littlefuse, or prior approved equal.

Part 2 - Products

- Circuit breakers shall be appropriate for the equipment in which they are being installed.
- 10,000 AIC minimum for 120/208 volt systems.
- 14,000 AIC minimum for all 277/480 volt systems.
- The actual ratings shall be as per the short circuit analysis for the appropriate building.
- Circuit breakers for new 120/208 volt panelboards shall be bolt on type.
- Circuit breakers for new 277/480 volt panelboards shall be bolt on type.

- Fuses shall be dual element time delay type fuses.
- Minimum AIC rating for fuses to be 200,000 AIC.
- Panelboard main breakers, panelboard branch breakers 100 amperes and larger, distribution panelboard breakers, and switchboard breakers shall be fully electric type. These breakers shall have at least 5 levels of adjustment, equal to Cutter Hammer "Digitrip OPTIM". Where 5 levels are not sufficient for CLEAN coordination, the 10 levels of adjustability of the Digitrip OPTIM – 1050 is required. Enhanced thermal magnetic breakers are not to be used and will not be considered. THIS PARAGRAPH SHALL BE INCLUDED IN ALL SPECIFICATIONS PREPARED BY ENGINEERING CONSULTANTS. This information shall also be passed on to bidders in situations where contractors, such as CM at risk contractors, are formulating budgets during the early stages of project development.
- All switchboards shall have electronic interlocks for selective tripping.
- All fuses for new equipment shall be rejection type fuses with approved rejection pins at all disconnects.

Part 3 - Execution

- Where multiple breakers are indicated on the drawings they shall be provided with a common trip and not as separate breakers "strapped" or "tied" together.
- Fuses shall be installed in such a manner that the fuse rating can be read from the front of the panel or switch without having to remove or rotate the fuse.

End of Section 26 43 00

DIVISION 26 - ELECTRICAL

Section 26 43 16 - Ground Fault Protection Systems

Introduction

All building main distribution systems shall have a ground fault protection system as a part of the secondary main disconnect at the building. This is required per the NEC for services of 1000 amps and larger.

GFI receptacles shall be used for drinking fountains and wherever a receptacle is within 6' of a sink or an emergency shower and where otherwise required by the NEC or good engineering practice.

GFI receptacles shall not be feed through type. Each location required shall have its own GFI receptacle.

It may be necessary to add GFI protection to services where an adequate ground is not available and where danger of electrocution is possible. An example of this would be an overhead crane where only a three-wire system has been connected to the service and where the danger of electrocution is greater than the possible danger from loss of power to the overhead crane.

All kitchen receptacles shall be GFCI per the NEC. Refrigerators shall be placed on 30-milliamp GFCI receptacle.

Part 1 - General

- Provide complete submittals for all devices supplied under this section.

Part 2 - Products

- GFI relays provided as a part of a main switchboard shall be as recommended by the manufacturer of the switchboard.
- GFI receptacles shall be heavy-duty specification grade receptacles similar to Plug back Hubbell GFRST20Snap.

Part 3 - Execution

- Install all devices in accordance with the manufacturer's recommendations. For service entrance systems, the device shall be tested following installation in accordance with NETA testing standards.
- Each GFI receptacle shall be tested for proper operation following installation.

End of Section 26 43 16

DIVISION 26 - ELECTRICAL

Section 26 51 00 – Interior Lighting

Introduction

Lighting utilizes approximately 40% of the electrical energy consumed here at Pima Community College. In order to conserve the energy it is very important that the lighting design be energy efficient. Soffit lighting must be accessible.

Consideration for maintenance of the light fixtures needs to be taken into account also. If a lamp is known to have a short life or a fixture manufacturer is known for having problems with his equipment make sure to eliminate them from consideration as a manufacturer. Use linear type fixtures whenever possible. Recessed compacts are to be minimized. Long lead, specialty lighting shall be avoided and where the design team request a variance the final approval is by Pima Facilities Operations.

Light levels should be appropriate for the task and per the following guide in Part 1 - General.

Design Guidelines

- Lighting design shall comply with current IESNA guidelines and application notes, with selection of the median illuminance as the target optimum, not the minimum. In all areas designated higher than IESNA category C, specified illuminance shall be on task, with ambient illuminance generally task/3. In all areas, lighting targets shall be achieved by the most current energy efficient technology that meets the requirements of this section.
- Incorporation of natural daylight, and daylight-supplementing artificial light.
- Area lighting by high-CRI linear tube fluorescent with specular reflectorized interior luminaire. For applications that do not involve frequent switching, use fully electronic instant start parallel-circuit ballasts.
- Task lighting by LED lamps with laterally offset placement so as not to cause direct or veiling glare.
- Conference room dimming: provide continuous architectural-dimming (to 10%) with linear fluorescent luminaires or LED fixtures in place of incandescent can downlights. Fluorescent dimming should be avoided where possible and use in limited spaces. Pima Facilities Operations shall approve fluorescent dimming.
- Reflectorized technologies for interior luminaires.
- Areas with visible daylight may use continuous-dimming photocell-controlled variable light output devices except those controlled by non-defeatable occupancy sensors. Daylighting contribution to be considered in calculation of IESNA target illuminance.
- Fluorescent lamps must meet the Federal TCLP mercury limit of 0.05mg./L
- LED lighting is encouraged as applicable to the desired lighting result. Utilize high quality fixtures with proven industry records for endurance.
- T-8 fixtures and lamps shall not be used unless with prior approval of the Pima Facilities Operations

Prohibited technologies include:

- Rapid start systems (non-dimming applications)
- Tungsten filament incandescent except quartz-halogen

- T12 fluorescent
- VHO and SHO lamps
- Mercury vapor lamps
- U-shaped lamps (except for CFLs)
- Small-cell paracube grates and large cell paracube fixtures where the lamp is not centered into the cell
- Magnetic fluorescent ballasts
- Series-circuit ballasts
- Indirect lighting in restrooms, corridors, and utility areas
- Neon systems of any type

Vacancy Sensors shall be specified and installed in accordance with EPA Green Lights guidelines, with control technology appropriate to the application. Areas with video display terminals shall be primarily illuminated by task lighting, use of overhead luminaires in each space to be evaluated for Visual Comfort Probability. Visual acuity factors are to be treated as minus weighting factors.

Discouraged Practices

- Indirect cone and soffit lighting
- Fixtures inaccessible from a landing or walkway.

Two level Lighting control should be provided in areas where multi use of the area would require various levels of light control. Where a greater variation on the lighting is required then the use of linear fluorescent fixtures with electronic dimming ballasts or LED fixture are is preferable as far as energy consideration than the use of incandescent fixtures with dimmers

Minimize the use of incandescent and quartz halogen type light sources since they are both expensive to operate (in both energy and heat gain) and maintain. Prior approval from the Pima Facilities Operations must be obtained prior to design using either of these light sources.

Where remodeling is being done in an area, it shall be considered to be part of the scope of work to bring the existing lighting in the area into compliance with this section.

In both new lighting and remodeling type lighting projects it shall be required to perform lighting calculations for the proposed systems and to submit point-to-point, area and lighting density calculations. Provide cut sheets for the fixtures proposed as a part of the schematic design of the project.

Part 1 – General

- Contractor to provide submittals of all light fixtures, with actual ballast type when applicable, and lamp types utilized.
- **Lighting Levels**

The following information shall be used by the designer in developing a lighting system for each specific project

based on IES recommended practices, codes and ordinances, life safety requirements and good engineering practices. Major deviations due to engineering decisions shall be documented in writing and discussed with the Pima Facilities Operations during the design development stage or schematic design stage. When in doubt, call for a presentation by the College.

- **College Lighting Standards**

Lighting levels at desk or tables tops shall be:

- Hallways: 25-foot candles average maintained foot-candles.
- Public areas: 30-foot candles average maintained foot-candles.
- Offices: 50-foot candles average maintained foot-candles.
- Reading rooms: 50-foot candles average maintained foot-candles.
- Classrooms: 50-foot candles average maintained foot-candles.
- Laboratories: 70-foot candles average maintained foot-candles.
- Machine Shops/Workshop: 100-foot candles average maintained foot-candles.

Minimum lighting standards shall be defined as average maintained foot-candles (within the range of -10% to +25%) over the life of the lamps, unless otherwise pre-approved by the College.

- **Preferred Lighting Densities**

The maximum lighting power density (LPD) for any building may be calculated by either the Complete Building Method (Table 2.1) or the Area Category Method (Table 2.2)

Table 2.1
Complete Building Method

Building Type	Max. Lighting Power Density (W/sf)	
	Goals	Max *
General Commercial or Industrial Work Buildings	0.8	
Grocery Stores	1.2	
Industrial or Commercial Storage Buildings	0.5	.8
Medical Buildings and Clinics	1.0	A.R.
Office Buildings	1.0	1.8
Religious Worship, Auditorium/Convention Centers	1.3	A.R.
Restaurants	1.0	
Retail and Wholesale Stores	1.3	A.R.
Schools	1.2	
Theaters	1.0	
All Others	0.5	

*AR means "as required"

Table 2.2
Area Category Method

Area Type	Max. Lighting Power Density (W/sf)	
	Goals	Max *
Auditorium	1.3	A.R.
Bank and ATM's	1.2	1.8
Classrooms	1.3	1.8
Convention/Conference/Meeting Centers	1.0	2.0
Corridors, Restrooms, Support Areas	0.5	
Dining	0.8	1.4
Exhibit	1.5	2.0
General Commercial and Industrial Work	0.8	A.R.
Grocery	1.3	A.R.
Hotel Function	1.5	
Industrial and Commercial Storage	0.4	1.8
Kitchen	1.5	
Lobbies: Hotel Lobby	1.5	
Main Entry Lobby	1.0	
Malls, Arcades, and Atria	0.8	
Medical and Clinical Care	1.2	A.R.
Office	1.0	1.8
Precision Commercial and/or Industrial Work	1.3	A.R.
Religious Worship	1.4	
Retail Sales, Wholesale Showrooms	1.4	
Theaters: Motion Picture	0.7	
Performance	1.0	A.R.

* AR means "as required"

Part 2 – Products

- Light fixtures are to be the product of a manufacturer of high quality light fixtures generally used in an industrial or commercial type setting. Fixtures shall be UL or CSA listed and certified.
- Fluorescent fixtures shall utilize electronic ballasts (not hybrids). Ballasts shall be Advance, Universal/Magnetec or prior approved equal as manufactured. All ballasts shall be CBM certified. Crest factor shall be not greater than 1.7. Harmonic distortion shall be less than 10%. Ballasts/ fixtures shall have internally mounted code conforming disconnect devices.
- Linear fluorescent lamps for 4' or 8' fixtures shall be type T8 32 or T5 28 watt 4 ft. lamps (tandem 4' lamps in 8' fixtures) energy saving lamps and shall be compatible with the type of ballasts supplied (and must be certified as such by both the manufacturer of the lamps and the manufacturer of the ballasts).
- Lamps shall be 3500°K with a CRI of 85. New buildings shall utilize 3500°K lamps. Lamps shall be rated for 24,000 hrs. minimum. Lamps shall be non-hazardous and disposable by normal means.
- For smaller than 4' lamps it is recommended that compact biax lamps be utilized rather than the use of u-tube type lamps. (48" U tubes are not permitted.)
- Ballasts shall be installed such that they are contained within the fixture. Where this is not possible the ballast shall be installed clear of any combustible material and in an accessible location. Ballasts for recessed non-linear type fixtures shall be located between the fixture housing and the junction box.
- Where HID type fixtures are used utilize ballasts without igniters and specify that the igniter be integral with the lamps.

- All ballasts for HID fixtures shall be high power factor/low noise/low emf type ballasts.
- Compact fluorescent ballasts shall be highest quality, HPF, minimum THD and maximum efficiency.

Part 3 – Execution

- Light fixtures shall be installed so that they are accessible for maintenance.
- Reference 26 05 29 for supports.
- Fixtures mounted in a plaster or drywall type ceiling shall be rigidly supported in an approved manner using channels connected to the ceiling support system
- Provide plaster frames for all fixtures requiring them.
- Light fixtures mounted flush in fire rated walls or ceilings shall be rated to the wall/ceiling rating.
- 3/8" light fixture whips may be utilized when fixture whip comes from the factory attached to the fixture via a steel box connection. Wire size shall not be less than #18 THHN. Box connectors must have a locknut, i.e., pop in type connectors will not be permitted. Lengths shall not exceed 6'0". (Tandem whips may be longer with Pima Facilities Operations approval.) Whip will be secured within 18" of J-box.
- Removable snap in entrance fittings shall be secured to the fixture body using a #8 (minimum) self-tapping screw.
 - 2x2; 2x4; 1x4; 1x6 and 1x8 types of light fixtures including recessed can type fixtures installed in grid ceilings shall be supported using not less than #12 gauge steel galvanized support wire and earthquake clips shall be installed. Each rectangular or square type fixture shall have a minimum of two support wires attached at opposite corners. Each recessed can type fixture shall have a minimum of one support wire. Support wires shall be secured attached directly and independently to the building structure with minimum size ¼" galvanized steel anchors (use expansion type anchors when in concrete). Wires shall have a minimum of three twists (turns) at each attachment point. Deflection on the support wires shall not exceed 10-degrees from plumb. Refer to Section 26 05 29 – Hangers and Supports for Electrical Systems.

End of Section 26 51 00

DIVISION 26 - ELECTRICAL

Section 26 52 13 – Emergency, Egress and Exit Lighting

Introduction

Provisions for emergency lighting should take into consideration the requirements for location of emergency exit lights in accordance with the new ADA and the requirements of the NFPA for exit lights.

In general for new buildings, it is required that all emergency lighting be supplied through the use of an electric generator. Each floor should have its own emergency panel and all emergency lights should be supplied from that panel.

On existing buildings where an emergency generator exists, all new emergency lights should be connected to that system. On buildings without an emergency generator system utilize 2 hour emergency battery packs in fixtures where required.

Do not wire light fixtures with power from two different emergency power systems.

For corridor emergency/night light circuits consider using florescent fixtures with PL type lamps at either 13 or 26 watt levels or LED.

Emergency lights located in classrooms or labs where a fully lit fixture would cause problems with the capability to darken the room (where a dark room is necessary for the room's operation) shall be switched via a lighted red toggle switch.

Part 1 - General

- Provide submittals on all emergency light fixtures.

Part 2 - Products

- Emergency or exit lights shall be the LED type low power use.
- Clear plexiglass exit signs, if used, shall have factory backings to prevent reading the words backwards.
- Battery packs should use the Nicad type batteries with a minimum of 10-year life.
- Where emergency lights contain battery packs the emergency ballast shall be as manufactured by Iota or approved equal.
- Fluorescent fixtures with 4 ft. lamps shall utilize 1000 lumen battery packs when battery packs are permitted.
- HID Lighting shall not be used for emergency lighting.

Part 3 - Execution

- Where used in classroom situations it is generally considered that all emergency lights should be capable of being turned off via normal light switches. However in case of an emergency or loss of power, and where possible they shall all be energized to illuminate the means of egress. Emergency lights shall be supported by the same criteria as normal light fixtures. Use necessary relay and control circuitry to accomplish restoration of emergency and egress lighting.

End of Section 26 52 13

DIVISION 26 - ELECTRICAL

Section 26 55 61 - Theatrical Lighting

Introduction

Since theatrical lighting is a very specialized lighting system, it should be left to be designed by experts in this field of lighting. On projects such as this, it is required that the engineer responsible for this area of design be experienced in this type of design and should provide documentation in the form of past projects engineered which would back up his claim.

Documentation required on this type of design would be providing a minimum of two proposals for the type of design proposed. Each should include back up information such as type of equipment planned (including cut sheets), typical life expectancy of equipment (including bulbs and ballasts where applicable), and cost estimates for each type of lighting system.

Design should take into account the requirements of maintenance on the system and the reliability of the equipment. For this reason, we would expect to have included in the design high quality equipment by the top manufacturers of this type of equipment.

Theater design should include design calculations and computer printouts on a point-to-point basis. Cut sheets of intended products shall be provided at the design development phase.

The electrical consultant shall supervise the lighting design and seal the plans.

Part 1 - General

- Complete submittals of all equipment proposed should be provided.
- Maintenance and operational manuals should be provided (minimum of 4 sets) at completion of project.

Part 2 - Products

- All products should be the product of top quality manufacturers and should be designed for the purpose for which it is used.
- All products should be U.L. listed or certified.

Part 3 - Execution

- All equipment should be independently supported to a minimum of a 200% safety factor to the building structure.
- All equipment should be located such that it is accessible for maintenance or can be made available for maintenance through normally available methods.

End of Section 26 55 61

DIVISION 26 - ELECTRICAL

Section 26 56 00 - Exterior Lighting

Introduction

When designing site lighting for the College two areas of major concern arise. The first and most prominent is that of safety for the students and faculty members. Since many times students need to be out and around the facility at late hours, it is important to provide lighting such that they can see well enough to feel safe when they are traveling from one building to another.

Lighting design should be in keeping with IES Lighting Standards and the Pima County Lighting Ordinance. Follow the ordinance. Special situations may receive a variance. Submit written requests to the College for written approval.

As a part of the design, we expect to see details of both bollard and light pole foundations. A Structural Engineer shall seal foundation designs.

Metal halide shall not be used unless approved by Pima Facilities Operations.

Low-pressure sodium sources are not to be used. High-pressure sodium, fully shielded is the preferred source.

Light fixtures should be located in such a manner that they can be easily maintained using standard equipment. Where fixtures cannot be easily accessed, the use of hinged poles shall be required. All exterior building light fixtures and poles shall be readily accessible and not restricted by other site improvements.

The design should be made in a manner such that is both energy efficient and cost effective as well as meeting the requirements for the local regulations.

The design should be flexible for both the field installation for expansion and for maintenance.

Where large areas are involved, provide handholes for maintenance use to trouble shoot the underground wiring when needed, and to allow for easier expansion if required in the future.

As part of the design development phase, provide cut sheets and point-to-point design calculations for all site lighting.

Where site lighting is to be designed either on the fringes of campus or off campus, insure that no light trespass occurs.

Refer to Section 32 33 00 – Site Furnishings; as it pertains to street lighting. Ingrade lighting shall be avoided.

Part 1 - General

- Provide submittals on all fixtures, including poles, bases, and ballasts at the Schematic Design Phase.
- Pole foundations are required for all lighting poles. These shall be engineered concrete foundations, engineered by a structural engineer, registered in the State of Arizona.
- All metal parts of lighting systems shall be bonded to ground. This includes the steel rings on concrete pull boxes.
- Pole foundations shall be grounded with 20 ft. of bare #2 copper wire buried below the concrete foundation.

Part 2 - Products

- Provide high quality products that are both architectural in nature and have an efficient lighting design.

- Use enough fixtures to provide adequate light especially in exterior corridors or areas between buildings to allow proper levels for personnel safety.
- Where available match fixtures in surrounding areas to be able to allow some continuity with the lighting in a general area.
- Light poles need to be designed for a minimum of a 100 mph wind loading. (80 mph + 1.3 gust factor)
- All pole-mounted fixtures shall be fused and shall be breakaway type.
- Pole mounted fixtures shall have fuses in base of pole with handhole access.

Part 3 - Execution

- Include requirements for aligning light fixtures, light poles, and bollards to be both level and uniform in layout and light distribution.

End of Section 26 56 00

DIVISION 27 - COMMUNICATIONS

Section 27 20 00 - Data Communications

Introduction

The scope includes a complete telecommunication system that includes riser cables, station wiring, terminations, termination devices, grounding and minimum sizes of MDF and IDF rooms.

Part 1 – General

- Refer to Pima Community College IT Design Standards Specifications.

Part 2 - Description of Work

- Refer to Pima Community College IT Design Standards Specifications.

Part 3 - Products

- Refer to Pima Community College IT Design Standards Specifications.

Part 4 - Acceptance Testing

- Refer to Pima Community College IT Design Standards Specifications.

Part 5 – Demolition

- Refer to Pima Community College IT Design Standards Specifications.

End of Section 27 20 00

DIVISION 27 - COMMUNICATIONS

Section 27 32 26 – Blue Light (Ring-Down) Emergency Telephones

Introduction

Auxiliary Systems and Communications related support systems.

Part 1 - General

- Refer to Pima Community College IT Design Standards and Specifications.

Part 2 - Products

- Refer to Pima Community College IT Design Standards and Specifications.

Part 3 – Emergency “Blue Light” Phone Systems

- Refer to Pima Community College IT Design Standards and Specifications.

End of Section 27 32 26

DIVISION 27 - COMMUNICATIONS

Section 27 53 13 - Clock Systems

Introduction

Clock systems shall be provided for all new buildings when specifically identified in the Project Scope of Work. The College has a master clock system, which receives a signal from the National time standard located in Colorado. All campus clocks are synchronized to this signal from the master clock. Therefore, it is imperative that the specification and drawings include requirements for connecting the new buildings to the plant distribution system.

Signal systems shall be provided for all new classroom type buildings and construction. The signal system shall be programmable through the building master clock system.

Bell system wiring shall be run with the clock system.

Each new or renovated system shall incorporate a building submaster clock to isolate each building in case of a fault on the main campus master clock.

Part 1 - General

- Provide complete submittals on all new clock systems including complete maintenance and operation manuals for each new system installed.

Part 2 - Products

- Compatible with the present Master time system, which is manufactured by Simplex Time Recorder Company.
- Any substitute must prove that it is compatible with this system.
- The existing system is a 24-vdc impulse system with a 24 -dc 3 wire correction. All clocks should be semiflush mounted. Each clock shall have an integral two lobe 5 minute catch up cam.
- Wiring color code should be in accordance with Section 28 05 53 – Identification for Electrical Safety and Security.

Part 3 - Execution

- For rearrangement type projects final tie-in of clocks to building system will be by the College Facilities Electric Shop.
- Final tie in of new building systems with the campus systems will be by the College Facilities Electric Shop.
- Testing for new facilities shall be done with factory trained representative of the manufacturer, and Pima Facilities Operations

End of Section 27 53 13

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Section 28 05 53 - Identification for Electronic Safety and Security

Introduction

To provide ready identification of power source for maintenance personnel.

Part 1 – General

- The following items are to be identified as to source of power:

- Receptacles
- Safety Switches
- Motor Starters
- Junction boxes
- Snap Switches on inside of plate with indelible felt-tip marker

- The following items are to be identified as to what they service:

- Safety Switches
- Motor Starters
- Panelboards
- Switchboards
- Time Clocks

- The following items are to be identified to match the identification indicated on the drawings:

- Panelboards
- Switchboards
- Transformers

- Other items that require identification will be identified in the section pertaining to them.

Part 2 - Products

- For panelboards, safety switches, motor starters, switchboards use black on white plastic engraved identification signs attached using #6 self-tapping screws.
- For receptacles use acrylic labels self-adhesive by “Brother P-Touch” equipment or approved equal.
- For wires use vinyl impregnated cloth tags.
- For color-coding cables use vinyl marking tape.
- For j-boxes write in large letters on cover using an indelible magic marker. Where exposed, identification is to be on inside face of cover.
- Panelboards shall have typewritten directories indicating actual room numbers and any other pertinent information for the circuit served. (I.E. COPIER ROOM 131, EF-3, NW CORNER OF ROOF, RECEPTACLES E & W WALLS RM 242). Verify room numbers with College, prior to typing the directories. Use proper room numbers. Note new room numbers on as-built drawings.

Part 3 - Execution

- Require that the new typewritten panel directories be installed after each project or remodel, updated to reflect all changes. Removed panel schedules shall be returned to the Pima Facilities Operations.
- J-boxes for fire alarm circuits shall be painted RED and labeled using an indelible black marker "Fire Alarm".
- Identify ground wires and neutral conductors at all j-boxes, pull boxes, or wherever wires are accessible. Spiral tape continuous where accessible. Ground wires and neutral conductor's size #8 and below will have colored insulation.
- COLOR CODES for new work shall be as follows:
- All conductors shall have integral colored insulation.

POWER WIRING

PHASE	120/208 VOLTS	277/480 VOLTS 4160/13800 VOLTS
A	BLACK	BROWN
B	RED	ORANGE
C	BLUE	YELLOW
NEUTRAL	WHITE	GRAY
GROUND	GREEN	GREEN

FIRE ALARM WIRING

Refer to Section 28 46 20 – Fire Alarm Systems

End of Section 28 05 53

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

Section 28 46 20 - Fire Alarm Systems

Introduction

The fire alarm systems here at the College are integrated together into a single reporting system which reports to PCC police department. To maintain system integrity it has been decided that all systems shall be manufactured by Edwards Systems Technology and shall be compatible with the addressable multiplexed system as manufactured by Simplex. To maintain and insure system integrity with new projects, the College has developed a guide form specification, which must be edited by the engineer in charge of each particular project. Each fire alarm system specification must be evaluated on an item-by-item basis and the specification edited to be project specific. For example, some projects by the nature of the type of building and its occupancy will be required to have a voice evacuation signal. For most projects, the standard horns and strobes no longer will suffice. Smaller projects will not require the complexity of the design that the larger ones will require, and thus some of the specification may be deleted.

For new projects, it will be necessary to connect the system back into the central reporting system loop. This loop is composed of a series of cables routed through the existing tunnel network. During the preliminary design, it will be necessary for the engineer to discuss with the College Fire Safety representative as to the exact location of the point of connection to this loop.

For existing buildings, the system interconnection should be intact, and it will be necessary only to tie the new system into the existing loop at the point of connection.

Where only a few devices are required it will be necessary for the engineer to delete all non-applicable portions of the guide form specification and make it project specific.

Typically, the fire alarm systems are to be considered a higher quality system than what is normally used in a facility of this type. All new systems are to be fully addressable systems with horns and strobes throughout and in compliance with ADA and NFPA requirements. Smoke detectors are to be used in all corridors. Return air duct smoke detectors shall be provided for all AHU's over 2000 cfm per the International Mechanical Code. All conference rooms and classrooms are to have alarm indicators, with A/V's to be used in larger lecture halls.

Strobes are to be used in all restrooms. Pull stations are to be used at all exits from a floor on multistory buildings and at any and all building exits. In addition, provide pull stations where required by the NFPA 72. All mechanical rooms shall be protected using heat detectors. All electrical rooms, telecommunications rooms, storerooms, and janitor closets shall be protected using smoke detectors.

The requirement for message boards will be required in dormitories, large classrooms and lecture halls with an A3 Occupant load and where deemed required by the AHJ.

Elevators shall recall and monitoring shall comply with the latest AZ Elevator code.

Utilize Class A wiring to all devices on the system. Color codes shall be in accordance with College standards.

All conduits shall run concealed unless no other option is available. Conduit, wiring, j-boxes, etc. shall be installed in compliance with other areas of this standard. Conduits shall have a minimum separation of 6'. This is the College's decision and standards requirement.

All fire alarm systems designed and installed throughout the College shall be capable of being expanded easily and readily. In order to make this easier we would like to require that both alarm and magnet loops have at least 30% spare capacity.

For all new projects, it has been decided that the College will require the new system to be up and fully operational for a minimum of 5 days prior to having the College's State Fire Marshal do his final inspection. At the point in time that the contractor believes that the system is ready to begin the 5 day "burn in" the supplier will certify to the owner that the system is fully operational. Until receipt of this letter, the acceptance test will not be considered to have begun. During the acceptance test, no modifications to the system can be made. The Contractor may be permitted to remove or demolish the existing system where applicable and where permitted by the owner prior to acceptance of the new system by the owner.

Part 1 - General

- Provide in accordance with the standards set forth in the guide form specification and instructions from the Pima Facilities Operations during the pre-design conference.
- Design shall confirm to NFPA 72 "Performance Based Design, Partial Coverage", including special requirements of the International Fire Code, and the requirements of Pima Community College Environmental Health & Safety Department, Department of Risk Management & Safety Office of the Fire Marshal.
- The consultant shall complete comprehensive plans, and single line diagrams based on the system described in this section.
- The consultant shall perform voltage drop calculations as part of the Construction Document Submittal for looped signal circuiting. Signal circuits shall not exceed 70% loading in order to accommodate future system changes.
- Batteries shall support 24 hours of Standby Operation and 15 minutes of Alarm Operation.
- Provide heat detectors in elevator shafts, machine rooms. Set 20°F lower than sprinkler heads, to signal the FACP to shut down the elevators.
- The consultant shall show the following supervisory functions on plans and single line diagrams. All conductors shall be in metal conduit.
- Ethernet circuit from FACP, with jack, to network terminal board.
- Monitoring circuit from each elevator control monitoring circuit (in machine rooms) to the FACP.
- Monitoring circuit from Engine Generator to the FACP, to monitor generator running.
- The consultant shall provide emergency lighting in the vicinity of the FACP.
- Generally speaking, Graphic, LCD, or LED annunciation is not utilized.

Part 2 - Products

- Provide in accordance with the specification standards.
- Where pull stations are susceptible to nuisance vandal pulling, a protective local alarm type covering device shall be provided.

Part 3 - Execution

- Provide in accordance with the specification standards.
- Wiring color codes shall be as specified in Division 28 05 53 – Identification for Electrical Safety and Security. J-

boxes shall be identified as per division 28 05 53 – Identification for Electrical Safety and Security.

- Testing. Insert the following language at this section:
 - “The fire alarm system shall be 100% complete, operational and free from trouble or alarm conditions prior to a 5 day burn in time, during which the system shall operate under normal conditions with no modifications by the contractor. Owner testing and acceptance shall be in conjunction with the Contractors final testing and verification. At the end of this period the fire alarm system shall be tested and approved by the College’s State Fire Marshal. Only upon receipt of approval by the College’s State Fire Marshal shall this system be considered complete.”

End of Section 28 46 20

DIVISION 31 – EARTHWORK

Section 31 31 00 - Soil Treatment

Introduction

The work in this section includes treatment of soils under buildings for termites and under paved areas for control of vegetation.

Part 1 - General

- Provide certification as to chemical type, rate of application and a written warranty.
- Warranty for termites and weed growth on new work shall be for 5 years. In alteration/addition work where termite five year warranty is not available, contractor shall certify application rate.

Part 2 - Products

- Chemicals shall be EPA certified and approved.
- Chemical for weed control shall be "Surflan" pre-emergent and/or Round-up.

Part 3 – Execution

- To be completed by Pestmaster Services.
- Termite treatment is required on new and alteration/addition projects under all footings, along foundation walls and under interior slabs on grade and exterior porch slabs.
- Treatment for weed control shall be applied to soil below paved areas, both asphaltic concrete and concrete flatwork, on open soil area and areas covered with decomposed granite. Application of chemicals shall not be harmful to the roots of adjacent plants.

End of Section 31 31 00

DIVISION 31 – EARTHWORK

Section 31 31 00 - Soil Treatment

Introduction

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Part 1 - General

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- Warranty for termites and weed growth on new work shall be for 5 years. In alteration/addition work where termite five year warranty is not available, contractor shall certify application rate.

Part 2 - Products

- Chemicals shall be EPA certified and approved.
- Chemical for weed control shall be "Surflan" pre-emergent and/or Round-up.

Part 3 – Execution

- To be completed by Truly Nolan.
- Termite treatment is required on new and alteration/addition projects under all footings, along foundation walls and under interior slabs on grade and exterior porch slabs.
- Treatment for weed control shall be applied to soil below paved areas, both asphaltic concrete and concrete flatwork, on open soil area and areas covered with decomposed granite. Application of chemicals shall not be harmful to the roots of adjacent plants.

End of Section 31 31 00

DIVISION 32 - EXTERIOR IMPROVEMENTS

Section 32 01 16 – Flexible Paving Rehabilitation

Introduction

A specification section shall be provided for work under this section including Special Provisions and other qualifications as necessary to make the specifications project specific.

Consultants shall tailor their specifications to local practice and College requirements. Testing of materials will be by agencies hired by either the Contractor or the College.

Require repaving and stripping if staging or yard areas for construction are in an existing parking lot or an adjacent street.

Concrete surfaces shall be provided at motorcycle parking and in maintenance areas where oil or gas spillage could occur.

Minimum standard parking space size on the Pima Community College campus is 8'-4" wide x 18'-0" long. Minimum lane width is 20'. The universal 11'-0" wide handicapped space is standard with 5' unload zone, white or blue accessible sign on pavement and accessible sign on post complying with ADA requirements.

Accessible route ramp shall be provided when the project is located at an intersection and at other intervals along a street if crosswalks are provided. Inclusion of these ramps should be evaluated with the Project Manager.

Part 1 - General

- Damage to existing utilities shall be repaired and made good by the contractor.
- Cold patching may be used only as a temporary measure. Permanent patches must be hot mix.
- The most current versions of the Standard Specifications for Public Improvements and the Standard Details for Public Improvements by Pima County and the City of Tucson shall be used and referenced for this work.
- Consultant shall evaluate project sidewalks considering that heavy College maintenance vehicles will use some pedestrian sidewalks pathways for access to grounds and buildings. Provide design for these identified sidewalks and pathways that will provide the required structural support for College maintenance vehicles. In consultation with the College, identify those sidewalks and pathways that are most likely to provide this access.

Part 2 - Products

- There are no unique College requirements in this section. Generally, design mixes should conform to City of Tucson standard mixes.

Part 3 - Execution

- The most current versions of the Standard Specifications for Public Improvements and the Standard Details for Public Improvements by Pima County and the City of Tucson shall be used or referenced for this work.
- If asphalt patch is less than 25 sq. ft., hand method of placement and screeding can be used. Materials must be hot mix.
- If asphalt patch is greater than 25 sq. ft. or a critical area, use lay down machine.

- When working at curbs, widen excavation, form and pour curb, cut straight asphalt edge, and patch.
- All asphalt cuts shall be saw cut.
- Manholes and valves shall be adjusted to grade after paving. Final adjustment shall be provided with concrete paving patch to roadway grade.

End of Section 32 01 16

DIVISION 32 – Exterior Improvements

Section 32 31 00 - Fences and Gates

Introduction

The items listed below are unique to the Pima Community College requirements and shall be incorporated in to the specifications and drawings prepared by the Consultant.

Part 1 - General

- Refer to the Chain Link Fence Manufacturers Institute Voluntary Standards for Chain Link Fence Installation.

Part 2 - Products

- Fabric shall be 9 gauge, 2" weave w/Class 2 hot dipped galvanized finish, w/not less than 1.2 oz. of Zinc per square foot, applied before weaving, and with top and bottom selvages knuckled.
- Framing members (including post, rails, braces, gate frames) shall be Type 1 pipe, Schedule 40, hot dipped galvanized w/not less than 1.8 oz. of Zinc per square foot of surface: posts and rails shall have caps to exclude moisture; rails shall be attached to posts w/malleable rail end caps w/7/8" beveled steel brace band.
- Posts and rails shall be standard gauge steel pipe sized as follows:
 - Corner posts up to 6 feet tall: 2.375" O.D.; over 6 feet tall: 4.00" O.D.
 - Line posts up to 6 feet tall: 2.00" O.D.; over 6 feet tall: 2.375" O.D.
 - Gate posts for leaves up to 6 feet wide: 2.875" O.D.; for leaves from 6 to 13 feet wide: 4.00" O.D.
 - Gate frames: 2.00" O.D. structural grade pipe
 - Rails: 1.625" O.D. w/7" long (min.) mid-span expansion couplings
 - Tension wires: .177" O.D. marcelled steel tension wire w/Class 2, galvanized coating

Part 3 - Execution

- Foundations shall be concrete with a 28 day compressive strength of 2500 PSI, constructed w/top of footing 2" above adjacent finished grade and sized as follows:
 - Terminal posts: 16" dia. w/39" depth of post embedment
 - Line posts: 12" dia. w/39" depth of post embedment
- Terminal posts shall be braced with 1.625" O.D. rail installed between the midpoints of the post and the first line rail (in each direction at corners). Attach braces as rails; secure w/.375" dia/truss rods from line post to terminal post.
- Bottom of fabric shall be 2" above adjacent finished grade.
- Attach fabric to posts, rails, braces and tension wires at 15" o.c. (max); attach fabric to posts w/tension bars and clips; stretch fabric between terminal posts or every 100' whichever is less.
- Gate hardware for swing gates shall include three hinges per leaf, provisions for pad-locking with cast metal fork latch, drop bolt and drop bolt retainer; hardware for rolling gates shall include heavy duty track, ball bearing hangar sheaves, overhead framing and supports, guides stays, bracing and locking devices as desired.
- Gates shall be braced with midpoint bracing as for terminal posts and with a bottom rail.

End of Section 32 31 00

DIVISION 02- SITEWORK

Section 32 33 00 - Site Furnishings

Introduction

Benches, tables, bollards, bicycle racks, if appropriate to the facility, shall be included in the project. Generally, these items shall be anchored in concrete so as not to be removed. Specify items which can be readily replaced if damaged.

Part 1 - General

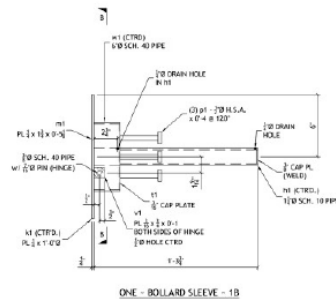
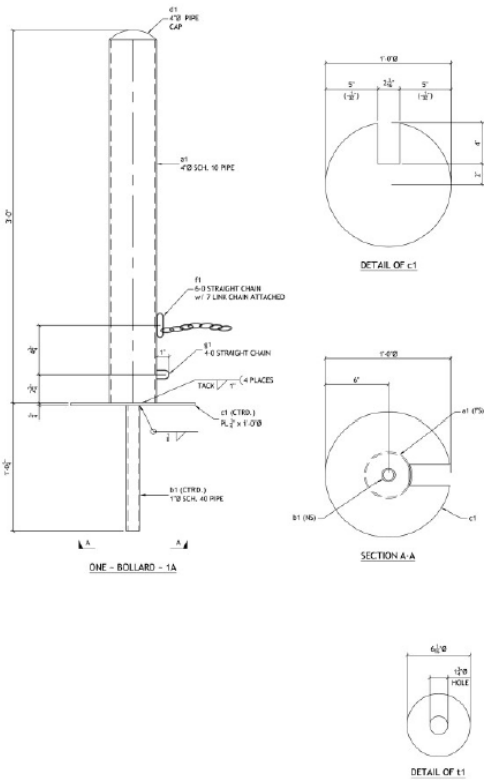
- There are no unique College requirements in this section.

Part 2 - Products

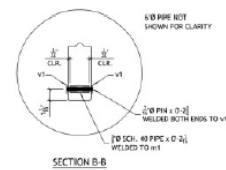
- Benches - Concrete, steel strap and perforated sheet steel benches are preferred to wood and fiberglass benches.
- Trash and Recycling Receptacles - Bigbelly solar powered trash and recycling stations. Steel trash and recycling receptacles with a powder coated finish. Frames are fabricated with heavy gauge pipe, angle or flat stock, or solid bar stock. Side panels are fabricated of perforated sheet steel or steel strap. Trash and recycling receptacles have liner and lids. Lids are inconspicuously cabled or chained to the frame. Place trash and recycling containers on a paved surface.
- Bicycle parking racks - ACI (Arizona Correctional Industries) Model MP 4113. Install below grade.
- Kiosks- Bulletin boards must be all weather.
- Tree Grates – Neenah Foundry, Urban Accessories, Canterbury International, Ironsmith. To be installed with frames.
- Drinking Fountains - Haws. Must be handicapped accessible.
- Building ID Signs - by College.
- Removable Bollards- Where removable bollards are required provide bollards as detailed on 32 33 00 – Site Furnishings - D1.

Part 3 - Execution

- There are no unique College requirements in this section.

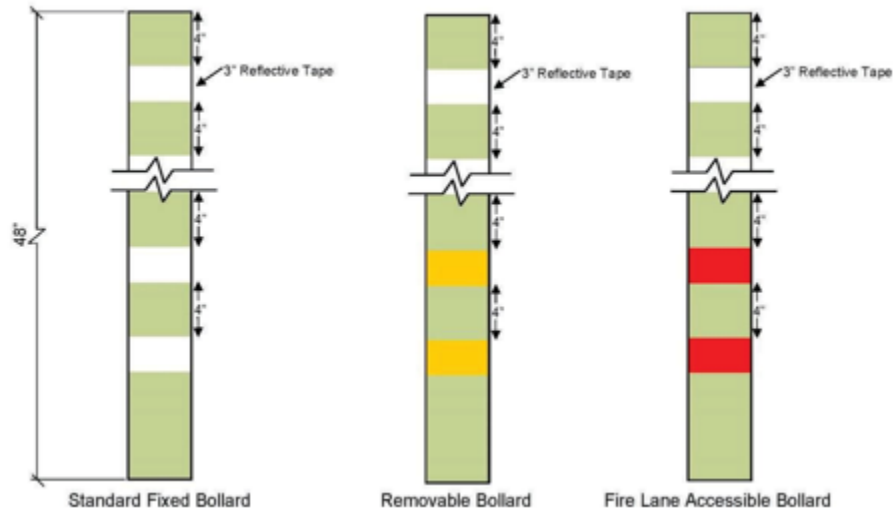


ONE	BOLLARD		1A	
1	4" SCH. 40 PIPE	2'-11"	m1	
1	1/2" SCH. 40 PIPE	1'-0"	m1	
1	PL 1/2 x 12	1'-0"	c1	ROUND, SEE DETAIL
1	4" CAP	---	q1	
1	6-6 STRAIGHT CHAIN	---	f1	w/ 7 LINK CHAIN
1	4-6 STRAIGHT CHAIN	---	g1	CUT
ONE	BOLLARD SLEEVE		1B	
1	1/2" SCH. 40 PIPE	1'-2"	m1	
1	PL 1/2 x 12	1'-0"	m1	ROUND, SEE DETAIL
1	PL 1/2 x 2	0'-5"	m1	SEE DETAIL
3	2" H.S.A.	0'-4"	d1	@ 120°
1	PL 1/2 x 6 1/2	0'-4"	f1	ROUND, SEE DETAIL
3	PL 1/2 x 1	0'-1"	v1	
1	4" SCH. 40 PIPE	0'-2"	m1	
1	1/2" PIN	0'-2"		
1	1/2" SCH. 40 PIPE	0'-2"		



PIMA COMMUNITY COLLEGE MANUAL OF DESIGN SPECIFICATION STANDARDS	
STANDARD DETAIL:	REMOVABLE BOLLARD
DETAIL NO:	32 33 00-D1

Campus Standards for Bollard Appearance



End of Section 32 33 00

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 32 80 00 – Irrigation

Introduction

As with layout plans and details, specifications shall be coordinated with those of the other design team members. Electric power shall be supplied for controllers and water for the system.

As with layout plans and details, specifications shall be coordinated with those of the other design team members. Electric power and a phone line shall be supplied for the controllers and water for the system.

Part 1 - General

- Damage to existing systems or utilities shall be repaired and made good by the contractor.
- Existing irrigation systems serving plants that remain on site and beyond shall stay fully functional and be protected from damage during construction.
- Any irrigation equipment removed shall be salvaged to the College.
- Materials and installation shall be guaranteed for 2 years.
- Landscaped areas used as Contractor's storage yard and areas impacted by construction shall be restored to pre-existing condition at completion of project.

Part 2 - Products

- The following irrigation equipment is preferred by the College:
 - Controller – "Calsense" controller only with radio remote and Calsense 3000 with Ethernet.
 - Backflow Preventer - Watts, reduced pressure type (for domestic water supply connections).
 - Master Valve – All systems shall have a master valve wired to the controller after the point of connection (POC)
 - Flow Meter – All systems shall have a "Calsense" flow meter installed downstream of the master valve. Flow meter shall be wired to the controller and compatible with central control system.
 - Filter - Agrifim
 - Remote Control Valve (RCV) – Rainbird PSEB-R for potable water systems. Rainbird PSEB-R with non-potable handle for reclaim water systems.
 - Ball Valves - Brass body ball valves
 - Quick Coupling Valves (QCV) – Rainbird 44 DRC for potable water systems. Rainbird 44 DLRC for reclaimed water systems. Also furnish 2 valve keys fitted with ¾" swivel hose ells.
 - Pressure Reducer - Senninger
 - Valve Boxes – Carson with locking lid. Sizes for 1" RCV – 12" Standard; 1 1/2" and 2" RCV – 18" Jumbo. For sizes QCV's - 9" dia. X 10" deep. On reclaim water systems all boxes shall be purple in color. On potable systems boxes shall be green in turf areas and brown/tan in planting areas.
 - Turf Rotors – Hunter I-20 Ultra, I-25 Ultra, I-40 Adjustable, and I-40-ON. Rotors shall have purple tops when used in reclaimed water systems.
 - Rotator Sprays - Hunter Pro-Spray 04-40-CV for potable water, Pro Spray 04-40-CVR for reclaimed water. Hunter MP Rotator Nozzles, 1500, 2000, 3000.
 - Pop Up Sprays –. Rainbird SAM-PRS RD-04 w/check valve, 30 PSI for reclaimed water.
 - Bubbler Heads – Rainbird Bubbler 1404 – 1 GPH and 1408 – 2 GPH
 - Drip Emitters – Rainbird Xeri-Bug emitters. XB-10 and XB-20 only.

- Multi-port Emitters –Rainbird Xeri-Bird XBD-80. Multi-port emitters shall also be enclosed in an “Econo” emitter box, purple in color on reclaimed systems.
- Polyethylene Pipe - Distribution tubing size; .220". Drip system lateral size; .710"
- Polyethylene Fittings – AG Products compression type #710cc. Male barbed-typed fittings are not permitted.
- Polyethylene Dripline – Netafim Techline dripline tubing and Netafim fittings.
- End Caps - AG Products #710cctc.
- Polyvinylchloride (PVC) Pipe - Schedule 40 for pressurized lines, Schedule 40 for non-pressurized lines, Class 315 for non-pressurized, 1/2" dia. drip lines. Schedule 40 for all sleeves (I.D. of sleeves shall be a minimum of 1" larger than the O.D. of the pipe or wire bundle it will carry. Purple pipe shall be used on all main lines in reclaimed water systems.
- PVC Fittings – Spears Schedule 80 on all mainlines and Schedule 40 on all lateral lines.
- Threaded PVC Nipples - Schedule 80.
- Control and Common Wire - type THWN Neoprene insulated, single conductor; minimum wire sizes shall be as follows: common wire - 12 gauge, control wire - 14 gauge (12 gauge for runs over 1000').
- Splicing Materials: Spears ds-400 prefilled connectors and Spears ds-300 sealer: line splices are allowed only on runs of more than 500'.
- Teflon Tape - for threaded connections.
- Unions – Two schedule 80 unions slip x slip shall be installed on all valve assemblies including master valve.

Part 3 – Execution

- Formal Inspections with College present:
 - Layout (prior to trenching) of all piping, heads and other equipment.
 - Mainline trenches, mainline, water source point-of-connection and control wire valves, quick couplers, controllers, other equipment and electrical power connection.
 - Lateral piping and distribution tubing, spray heads, bubbler heads and drip emitters.
 - Final inspection upon completion of all work.
- Formal testing with College present:
 - Main line: tested for not less than four continuous hours at a static line pressure of not less than 100 PSI, with all isolation valves open, and all pipe uncovered.
 - Flush after installation of laterals and risers and test for water tightness and proper operation of lateral piping, filters, control valves, pressure regulators, end or run flush outlets and other equipment with all pipe uncovered.
 - Flush after installation and test for water tightness and proper operation of drip emitters and distribution tubing, spray heads, bubblers heads.
 - Final operational testing to demonstrate full coverage and proper function of automatic controls.
- Pipe and wiring shall be carried in separate Schedule 40 PVC sleeves under sidewalks and pavement with minimum burial depths as follows:
 - Pipe and wires under pavement - 24"
 - Pressurized lines - 18"
 - Non-pressurized lines - 12"
 - Non-pressurized drip laterals - 8"
 - Wire - 12"
- Sleeves shall extend 12" beyond edge of sidewalk and/or pavement.

- Minimum clearances between irrigation lines adjacent to or crossing other irrigation lines or those of other trades shall be as follows:
 - 1" diameter and smaller: 6" horizontally, 3" vertically
 - Larger than 1" dia.: 12" horizontally, 6" vertically
- Excavations shall allow for 2" (min) of sand bedding or earth fill when rock or unsuitable bearing material is encountered. Provide and compact backfill as follows:
 - Sand bedding or approved earth fill to a point 6" above the top of pipe (for pipe under paving provide 4" minimum sand bedding on all sides).
 - Approved fill free of lumps 1" in dia. and larger to 6" from the top of the trench.
 - Approved topsoil, as specified elsewhere to the top of the trench.
- Snake pipe in trench to allow 1 additional foot per 100" of pipe.
- Holes bored beneath pavement shall maintain an alignment tolerance of no more than 1" in 10', both vertically and horizontally.
- Pipe shall be cut only with an approved pipe cutter. Cuts with a hacksaw or knife are not permitted
- Polyethylene pipe shall be inserted into fittings 1/2" minimum. Minimum radius of poly pipe bends shall be 18".
- Backflow preventers shall be insulated with aluminum tape.
- Install filter immediately downstream of backflow preventer and upstream of control valves.
- Provide thrust blocks for pipe 1-1/2" in diameter and larger.
- All main lines shall have a continuous trace wire laid with the pipe.
- Provide QCV's at 150' (max) spacing along the mainline or around the perimeter of the project, as necessary; install QCV's in valve boxes and on swing joint assemblies perpendicular to adjacent finished grade unless otherwise noted – Schedule 80 1" TxT 900 + 1" Schedule 80 nipple.
- Install RCV's perpendicular to adjacent finished grade unless otherwise noted; provide a minimum of 30" slack in control wires at control valves to allow servicing. Allow 2" clearance between control valves and gravel sump beneath.
- Install end caps in "econo" type valve boxes.
- Install RCV assemblies (RCV, Filter, pressure reducer, QCV, sensor) in valve boxes.
- Tie control and common wires in bundles at 10' intervals.
- Wire splices shall be made in valve boxes.
- Group valve boxes, install no closer than 6" to adjacent walls and not further than 12" from walks, curbs, etc. Install all valve boxes flush with finish grade. Support valve boxes on bricks (min. four) below grade. Provide landscape fabric in the bottom of the box.
- Equipment within valve boxes shall be 4" below lid and quick couplers no more than 3".

- Install spray heads on triple swing joints 6" from adjacent walks, curbs, mowing strips, etc. and with the top of the head flush with adjacent grade.
- Install dripline with fittings from the same manufacturer.
- Install bubbler heads on double swing joints and with the distance from the bottom of the head to adjacent finished grade set at 2".
- Distribution tubing leading from the drip emitter to the surface shall not exceed 5 feet in length, shall extend 2" above adjacent finish grade and shall be secured in the soil with an anchor created by wrapping the tubing twice around a 3" length of 1/2" PVC pipe and buried 8" below grade.
- Affix a non-fading, weather resistant copy of Irrigation Diagram and controller name label to inside of controller cabinet door. The Irrigation Diagram shall show all valves operated by the controller, valve sizes and type of planting irrigated.
- For future expansion, add a minimum of 2 extra control wires to the furthest valve manifold in each direction.

End of Section 32 80 00

DIVISION 02 – EXTERIOR IMPROVEMENTS

Section 32 90 00 - Planting

Introduction

Designers are encouraged to use plant material in energy conserving, climate ameliorating ways. Combinations of deciduous and evergreen shade trees can do much to mediate weather and climatic extremes.

Designers shall refer to site paving drawings and coordinate size of plant pits so as to not undermine hardscape.

The addition of new lawns is restricted due to College agreements with the Arizona Department of Water Resources.

Part 1 - General

- Plant materials shall be selected from the most current revision of the Low Water Use/Drought Tolerant Plant List published by the Arizona Department of Water Resources, Tucson Active Management Area.
- Water harvesting measures should be considered where available.

Part 2 - Products

- Imported topsoil shall be Mesa Red natural, friable loam. Submit written evidence of tests for pH and total dissolved salts (TDS) prior to delivery. PH shall be between 6.5 and 8.0. TDS shall not exceed 1000 parts/million.
- Mulch shall be "Forest Magic" brand or other approved nitrogen stabilized (nitrolized) fine ground fir bark.
- Fertilizer shall be commercial Ammonium Phosphate w/an NPK ration of 16-20-0; use Agriform 20-10-5 formula, 21 gram tablets for salvaged and replanted plants.
- Soil sulphur shall be agricultural grade, pilled or granulated, containing 99.5% active and 0.5% inert ingredients.
- Manure shall be composted, well rotted, free of refuse and containing not more than 25% straw or other bedding material.
- Soil mix for backfilling shall be three parts topsoil to one part mulch with one pound Ammonium Phosphate and two pounds soil sulphur added per cubic yard.
- Tree stakes shall be three (3) inch diameter by eight (8) feet long, pressure-treated Lodgepole Pine, free of any weakening knots or other defect. Stake trees up to 15-gallon size with two (2) stakes. Larger sizes shall be staked or guyed.
- Guy wire shall be new, 12 gauge, annealed, galvanized.
- Chafing guards shall be new, 3/4" dia. reinforced rubber or vinyl hose, 12" long (min) or as necessary to protect tree from guy wires.
- Decorative rock "Desert Gold" or "Wildcat Red" in color, from a local source and shall consist primarily of particles 1/2" to 3/4" in diameter.

- Boulders shall be native Santa Catalina Mountain rock.
- Pre-emergent herbicide shall be "Surflan" or approved equal.
- Palm tying twine shall be natural fiber.

Part 3 - Execution

- New and existing utilities shall not conflict with planting.
- Where plant material will be placed in soil beneath existing pavement, especially asphalt pavement, or other condition where soil sterilant or other treatment potentially harmful to plant material may have been applied shall be tested for the presence of any such chemicals or condition. Affected soils shall be treated and/or excavated and disposed of in accordance with local codes.
- Minimum planting pit sizes shall be as follows:
 - One (1) gallon size container: 18" in dia.
 - Five (5) gallon size container: 36" in dia.
 - Fifteen (15) gallon size container: 60" in dia.
 - Twenty-four (24") inch box. 60" square.
 - Thirty-six (36") inch box and larger. 18" clear on all sides.
 - Depth of all pits no deeper than the rootball to prevent settling.
- Plant pits shall not undermine hardscape nor shall hardscape elements be placed over plant pits.
- Areas to receive ground cover plants shall be excavated in their entirety to 18" below finish grade and backfilled with backfill mix described above.
- Planting pit percolation rates to be determined prior to planting in the presence of Pima Community College representative.
- After water settling backfill, set plants lower than finish grade to create irrigation basins such that the crown of the root ball shall be 4" lower than surrounding finish grade. Basins shall be as wide as the plant pit. Top of rootball shall be flush with finish grade of the basin.
- 2" of mulch shall be incorporated into the top 3" of soil in irrigation basin areas.
- Root balls of existing palm trees to be transplanted shall have a minimum diameter of 4 feet plus the diameter of the trunk measure 12" above the ground. Vitamin B-1 shall be used per manufacturer's recommendations with the first watering.
- Salvage of existing trees from the project shall be performed by a firm approved by the College and with at least four years experience with this type of work. The work shall be guaranteed and conducted in a manner consistent with local practice. The College shall designate a holding area and source of irrigation for boxed or other wise temporarily stored trees.
- Restoration of turf operations shall include: loosening compacted soil to a minimum depth of 9", removing all rock and debris 1" and larger and adding approved topsoil to match original grade and compaction. 3" of composted, screened, weed free manure plus 2 pounds of Ammonium Phosphate (16-20-0) and 5 pounds of soil sulphur shall be added per 100 square feet and roto-tilled into existing soil to a depth of 6". Between the dates of May 15 and August 15, sow Cynadon dactylon (common Bermuda grass) seed at a rate of 3 pounds per 1000 square feet. Seed shall be 98% pure and have a germination

rate of 75%. Between August 15 and May 15, contractor shall provide to the College, but not sow, the appropriate quantity of seed. Roll seeded areas with a 50 pound per linear foot roller then mulch with one-half inch of screened manure.

- The landscape contractor shall maintain all planting until accepted. Maintenance operations shall include: watering, mulching, tightening or adjusting of tree ties, resetting plants to proper grade, restoration of irrigation basins, fertilization and weeding. Replacement materials shall meet all specifications of original materials
- Where existing lawns have been damaged by construction and are to be repaired by the contractor, follow these instructions:
 - Loosen compacted soil to a depth of 9" min.
 - Remove debris and rock larger than 1" and all contaminated soil.
 - Add topsoil to the level of original grade and allow for settlement.
 - Rototill into the top 6" a 3" layer of manure, 2 pounds Ammonium Phosphate (16-20-0) and 5 pounds of soil sulphur per 100 sf.
 - Broadcast Bermuda grass seed (98% pure, 75% germination) at the rate of three pounds per 1000 sf and cover with a thin layer of manure.
- Sod shall be cut, delivered and installed within a 24-hour period. Cultivate subgrade to a depth of 6" prior to placing topsoil and remove all stones and debris 1" and greater in dia. Place topsoil to a depth of 9" over cultivated subgrade. Topsoil shall consist of equal parts topsoil, sand and manure with 18 pounds soil sulphur, 50 pounds gypsum and 7 pounds Ammonium Phosphate fertilizer (16-20-0) added per 1000 sf.
- Maintenance for new or reestablished turf areas shall be as follows:
 - Maintenance period shall be for 90 days or a minimum of four mowings, whichever is longer, Turf shall be mowed to a height of 1/2" when a height of 1" is reached.
 - Spray heads shall be set 1" above finished grade, initially and reset once turf is established by the contractor at no additional cost. Irrigation shall not result in wilting, puddles or runoff.
 - After 3 weeks and again at the end of the maintenance period, fertilize with a fertilizer that provides one-pound available Nitrogen per 1000 sf.
 - Final acceptance will occur with a satisfactory stand of grass (solid, healthy growth, without bare spots) at the end of the maintenance period.
- Contractor shall cut palm ties, not broken naturally, after 4 months.
- Berms and swales shall be formed as continuous, smooth landforms with no obvious top or bottom to slopes or grade change from berm to swale.
- Install decomposed granite (DG) 1-3/4" to 2" deep, rake smooth and tamp with a roller of 100 pounds per linear foot weight, minimum. Finish grade shall be 2" below top of adjacent walks, curbs or other pavement. Apply per emergent herbicide, per mfg, instruction, before and after placing the D.G.
- Provide positive drainage away from buildings and structures. Direct runoff water to planting areas.
- All plant materials shall be guaranteed for 1 full year following substantial completion or replacement.

End of Section 32 90 00

DIVISION 33 – UTILITIES

Section 33 14 13 – Public Water Utility Distribution Piping

Introduction

Piping of site utilities – potable water & reclaimed water.

Part 1 - General

- Refer to Section 22 05 00 – Common Work Results for Plumbing for common piping materials and methods.
- Refer to Section 40 71 00 – Flow Measurement for meter requirements.

Part 2 - Products

- Pipe Schedule:

Service	Size	Pipe	Fittings	Joints
Potable and Reclaimed Water	Up to 3"	PVC - Sch. 40	PVC	Glued
	4" to 12"	PVC – C900 or Ductile Iron	PVC Ductile Iron	Push-on Mechanical jt
	Over 12"	Ductile Iron	Ductile Iron	Push-on, Mechanical jt

- Pipe
 - Ductile iron pipe and fittings to be cement mortar lined (interior) and coated with bituminous material (exterior) per AWWA. Mortar lining for reclaimed systems shall be double thickness.
 - PVC pipe, AWWA C900.
 - Reclaimed Water- PVC pipe shall be purple (Panatone 522C). Ductile iron pipe shall be encased in purple polyethylene.
- Valves - Buried
 - Potable - For pipe over 12" Butterfly valve conforming to AWWA C504.
 - Reclaimed Water- For pipe over 12" Butterfly valve conforming to AWWA C504.
 - Resilient - Seat gate valves for pipe up to 12".
- Joint Restraint Devices
 - Ductile iron mechanical joints – Megalug joint restraint.
 - Ductile iron flange connection – Megaflange joint restraint flange adapter.
 - Integral ductile iron joint – TR Flex restrained joint.
 - PVC pipe – EBBA Iron Sales Series 1700.
- Valve Boxes – cast iron box and cover

- Air Relief Valve Vaults – cast in place concrete with 30” diameter cover.
- Air Relief Valves – APCO Series 140C, cast iron body, SS float, SS lever, Buna – N seat.

Part 3 - Execution

- Potable water
 - Installation shall be per Tucson Water Standards.
- Reclaimed water
 - Installation shall be per Tucson Water Standards.
- Testing: Hydrostatic, no leakage permitted at 100 psig, witnessed by PCC Inspector before joints are concealed.

End of Section 33 14 13

DIVISION 33 – Utilities

Section 33 14 16 - Site Water Utility Distribution Piping

Introduction

Piping of site utilities – chilled water & heating water.

Part 1 - General

- Refer to Section 22 05 00 – Common Work Results for Plumbing for common piping materials and methods.
- Refer to Section 23 07 00 – HVAC Insulation for insulation requirements.
- Refer to Section 40 71 00 – Flow Measurement for meter requirements.

Part 2 – Products

- Pipe Schedule:

Service	Size	Pipe	Fittings	Joints
Chilled Water	4" and Larger	Ductile Iron, Lined	Ductile Iron, Lined	Bell & Spigot or Mechanical Joint
	16" and Over	May Use Concrete Cylinder	Concrete Cylinder	Bell & Spigot
	Below 4"	Type "K" Copper Seamless Hard Drawn	Wrought Copper	15% Silver Solder
Heating Water Pre Insulated Pipe System	All Sizes	Copper – Type "K" Seamless Hard Drawn	Wrought Copper	15% Silver Braze
		OR Schedule 40 Steel	OR Forged Carbon Steel	OR Bevel Welded

- Pipe & fittings
 - Ductile iron pipe and fittings to be cement lined and coated with bituminous material per AWWA.
 - Concrete cylinder pipe and fittings to be cement or cement-mortar lined and coated per AWWA.
 - Pre-insulated pipe system, Terra-Gard System by Perma-Pipe or approved equal
 - Copper carrier tube, ASTM B88, Type K, seamless, hard temper
 - Steel carrier pipe to be ASTM A53, seamless, carbon steel, Schedule 40
 - Polyurethane, closed cell insulation
 - PVC jacket per ASTM D1784
- Valves – Buried
 - Chilled Water
 - Resilient seated gate valves for pipe up to 12".
 - Butterfly valve for pipe over 12" conforming to AWWA C504 and Tucson Water Specification No. 1411
 - Heating Water

- Butterfly valve conforming to AWWA C504 and Tucson Water Specification No. 1411.
- Joint Restraint Devices
 - Ductile iron mechanical joints – Megalug joint restraint
 - Ductile iron flange connection – Megaflange joint restraint flange adapter
 - Integral ductile iron joint – TR Flex restrained joint
 - Concrete cylinder pipe – welded
- Valve Boxes – cast iron box and cover
- Air Relief Valve Vaults – cast in place concrete with 30” diameter cover
- Air Relief Valves – APCO Series 140C, cast iron body, SS float, SS lever, Buna –N seat

Part 3 - Execution

- Chilled water piping
 - Ductile iron pipe to be installed per AWWA C600 and Tucson Water Standard Specification No. 1401.
 - Concrete cylinder pipe to be installed per AWWA M9 and manufacturer’s recommendations.
- Hot water piping
 - Installed per pre-insulated piping system manufacturer’s instructions
- Testing: Hydrostatic, no leakage permitted @ 100 psig, witnessed by PCC Inspector before joints are concealed.

End of Section 33 14 16

DIVISION 33 – UTILITIES

Section 33 31 00 –Sanitary Sewage Piping

Introduction

Piping of site utilities – sanitary drainage.

Part 1 - General

- Pima County Standard Specifications and Details are applicable.

Part 2 - Products

- Pipe Schedule:

Service	Size	Pipe	Fittings	Joints
Sanitary	Up to 15"	PVC SDR-35	PVC	Bell & Spigot

- PVC pipe per ASTM D3034, SDR 35
 - PVC Fittings per ASTM D3034
 - Joints per ASTM D3212 with gaskets per ASTM F477

Part 3 - Execution

- Installation to conform to Pima County/City of Tucson Standards and Details.
- Testing per Pima County/City of Tucson Standards and witnessed by PCC Inspector.

End of Section 33 31 00

DIVISION 33 – UTILITIES

Section 33 40 00 – Stormwater Utilities

Introduction

Piping of site utilities – storm drainage.

Part 1 - General

- Pima County/City of Tucson Standard Specifications and Details are applicable.

Part 2 - Products

- Pipe Schedule:

Service	Size	Pipe	Fittings	Joints
Sanitary	Up to 18"	PVC SDR-35	PVC	Bell & Spigot
	Larger than 18"	Reinforced Concrete	Concrete Manhole	Gasket & Mortar

- PVC pipe per ASTM D3034, SDR 35
 - PVC Fittings per ASTM D3034
 - Joints per ASTM D3212 with gaskets per ASTM F477
- Reinforced concrete pipe to conform with AASHTO M242
 - Concrete manhole materials shall comply with Pima County/City of Tucson Standards and Details.
 - Joint materials shall comply with Pima County/City of Tucson Standards and Details.

Part 3 - Execution

- Installation to conform with Pima County/City of Tucson Standards and Details.
- Testing per Pima County/City of Tucson Standards and witnessed by PCC Inspector.

End of Section 33 40 00

DIVISION 33 – UTILITIES

Section 33 52 16.13 - Steel Natural Gas Piping

Introduction

Piping of site utilities – natural gas.

Part 1 - General

- Southwest Gas Corporation standards are applicable.

Part 2 - Products

- Piping and meters
 - Materials provided by Southwest Gas Corporation per its standards.

Part 3 - Execution

- Installation by Southwest Gas Corporation per its standards.
- Contractor to coordinate activities with Southwest Gas Corporation and provide adequate access to the site.

End of Section 33 52 16.13

DIVISION 40 – PROCESS INTERCONNECTIONS

Section 40 71 00 – Flow Measurement

Introduction

Meters are required on chilled water. Chilled water make-up boiler supply and boiler make-up water.

Part 1 - General

- Design, specify, furnish, install, and commission all utility meters required and owned by the College.
- Utility meters shall be designed and specified by the project Design Professional. Project contractor shall furnish and install all utility meters. Utility meter commissioning shall be a joint effort between the project contractor and the Design Professional and Pima Community College. The College will not accept any utility meter until it has been shown to be fully functioning and operational.
- Design shall include selecting, scheduling, and specifying each utility meter as would be done for any piece of specialized equipment.
- Review the proposed metering scope with PDC Mechanical Engineer early in the project to confirm the campus wide requirements are being fulfilled. Projects that interface with existing building systems may require a different configuration.
- Flow Meters shall be selected to handle the flow range they will encounter at present design conditions.
- Meters shall be connected to the College's campus data EMCS system via BACnet.
- All meters shall be capable of fully monitoring the building energy and water usage.
 - The meter shall be selected with BACnet/IP or BACnet mstp.
 - All meters will be non-intrusive.
 - Project control drawings and specifications shall include all the information, including, but not necessarily limited to, points, termination, and programming necessary to provide complete building energy use reporting on the College's EMCS in addition to the building EMCS (refer to Section 23 09 23 – Direct-Digital Control System for HVAC).
 - Metering submittal shall include information specific to the product(s) being proposed. At minimum, the following product information shall be provided for any utility meter product:
 - Product technical specifications (data sheet or cut sheet)
 - Installation/wiring/configuration manual
 - Technical or programming manual/guide
 - Owner's manual or maintenance guide
 - Troubleshooting guide
 - IT hardening guide
 - Pima Community College shall assist in reviewing the project contractor's utility metering submittal.
 - Project drawings and specifications shall include the following utility meter information as a minimum:
 - Domestic Water, Chilled Water, and Heating system, Meters:
 - Type of service (i.e., chilled water, Heating, or domestic water).
 - Size of meter, manufacturer, type, model number.
 - Location of meter, sensors, and remote readouts.

- Meter shall be located, including dimensions of installation if a specific location is necessary for proper operation.
- Meter or meter remote readouts shall be readily accessible and at a level (5'6") that can be read without using a ladder.
- Complete network topology diagram detailing serial and IP network configuration including:
 - IP configuration information for IP devices
 - BACnet/IP
 - BACnet MS/TP network configuration information for serial networks and BACnet devices (where applicable)
- Accuracy and Repeatability to meet federal guidelines for billable meter requirement.
- Domestic Water, Chilled Water, and Heating Water Meters:
 - Range: maximum flow, minimum flow, and normal flow expected at present design conditions.
 - Installation details: details shall be complete and include all necessary information, including, but not limited to, length of straight pipe required upstream and downstream, distance required from valves or fittings, any required concentric reducers and location of temperature and pressure sensors.
- Chilled Water and Heating water Meters:
 - All items necessary to allow the chilled water flow sensors to function as energy meters shall be specified and shown on the drawings and included in installation details.
 - Output of energy meter shall be in BTU's and totalized in MBTU's.
 - These additional items shall include, but are not limited to, temperature sensors, BTU totalizing computer, BACnet connection from the College EMCS system, programming requirements and software.
 - Delta-temperature transmitters shall be platinum 1000 OHM RTD, Where 1000 ohms equals 320F.
 - Delta-temperature sensors shall be matched pairs of calibrated sensors with an accuracy of 0.12% F.
 - Flow transducers shall be selected for the expected flow range encountered at present design conditions, pipe size and material. Particular attention shall be made to low flow conditions; specified accuracy shall be maintained under low flow conditions.
 - For all installations, an energy totalizing computer will be required.

Part 2 - Products (UTILITY METER REQUIREMENTS) – Discuss With PCC Planning Design & Construction

- Domestic Water Meter:
 - Meters shall read in gallons and totalized in KGAL.
 - Water meters shall have a local readout as well as a BACnet College EMCS system.
- Chilled Water and Heating water flow sensor:
 - Where an energy-totalizing computer is required, it will use the BACnet protocol for output.
 - Flow transducers shall be combined with supply and return temperature sensors.
 - Transducers and temperature RTD's will be factory calibrated matched sets.
 - Meters shall be capable of local or remote reading within the building close to the meter location.
 - Provide a BACnet connection to the College EMCS.

Part 3 – Execution

- Include energy meter data on the graphic screen as part of the building EMCS.

- Provide heating meters on the load side of all systems that use steam to water heat exchangers.
- The supply of any utility to a building shall not be activated until the specified metering is in place, functional, and has been commissioned.

- During the final phase of the project and before final close out, project contractor shall be required to prove that all utility meters are installed properly and function as designed and specified. The utility meter commissioning shall be accomplished by the contractor in conjunction with the project consulting engineers and Pima Community College. Proper functionality includes:
 - Proper installation of the meter and associated appurtenances according to manufacturer's installation recommendations, Pima Community College specifications, and all applicable local codes and standards. Follow NEC and Pima Community College standards for electrical, sensor, and network cabling. [In general, PCC should require all cabling installed in mechanical/electrical/storage or unfinished space to be in conduit, and any cabling not in conduit to be in cable tray or properly supported to the structure – not supported on other conduit, piping, or infrastructure.]
 - Meter accuracy performing as specified under all expected design flow conditions.
 - Local flow display installed as-specified, reading in the specified units.
 - BACnet interface communicating without error, providing 100% of requested data samples to client systems.
 - Require calibration data, O & M manuals, details, etc., to be submitted prior to joint commissioning of the meter(s) with the Design Professional and the College.

End of Section 40 71 00

DIVISION 40 – PROCESS INTERCONNECTIONS

Section 40 97 00 – Variable Frequency Drives

Introduction

This specification is to cover a complete variable frequency motor drive (VFD) consisting of a pulse width modulated (PWM) inverter output waveform (VVI, six-step, and current source drives are not acceptable) designed for use on a standard NEMA Design B induction motor. The VFD shall employ a 1600-volt full wave bridge rectifier, 5% impedance AC or DC Line Reactor, EMI/ RFI filters, capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output-switching device.

The drive manufacturer shall have a representative exclusively for HVAC products, both sales and service will be the same organization for sole source responsibility.

Part 1 - General

- Quality Assurance
 - Referenced Standards
 - Institute of Electrical and Electronic Engineers (IEEE) Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - Underwriter Laboratories: UL508C
 - National Electrical Manufacturer's Association (NEMA) ICS 7.0, AC Adjustable Speed Drives.
 - IEC 16800 Parts 1 and 2.
 - Qualifications
 - VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to UL listed are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
 - CE Mark- European Union Electro Magnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.
 - Acceptable Manufactures- ABB ACH Series, 550.
 - Substitutions must have written approval by the Design professional 2 weeks prior to date of bid. Written approval does not relieve supplier of specification requirements. All exceptions to this specification shall be submitted in writing to the Consulting Engineer at that time.
 - All VFD's shall be provided by the authorized local Rep/Distributor and be of one manufacturer. All HVAC OEM'S (AHU, Pumps, Cooling towers, etc.) shall allow VFD's to be shipped to factory for mounting or HVAC OEM units are to be deigned to interface/accommodate field mounting of VFD's.
 - All VFD's that are manufactured by a third party and "brand labeled", shall not be acceptable.
- Submittals
 - Submittals shall include the following information:
 - Outline dimensions, conduit entry locations and weight, customer connection and power wiring diagrams, technical product description include a complete list of options provided.
 - Compliance to IEEE 519- harmonic analysis for particular jobsite including total harmonic distortion (BOTH VOLTAGE and TDD). Using job specific electrical information the VFD manufacturer shall provide calculations showing total harmonic voltage distortion, is less than 5% at point of common coupling. Input

line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5 % impedance reactors, **no exceptions**.

Part 2 – Products

- Variable Frequency Drive
 - The VFD shall be listed ISO9001 and the package as specified herein shall be enclosed in a UL listed Type 1, 12 (indoor enclosures) or 3R (outdoor enclosure) as applicable/specified.
 - The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
 - Environmental operating conditions: -15 to 40°C to (5 to 104°F) ambient temperature continuous with no current de-rate. From 40°C (104°F) to 50°C (122°F) ambient temperature range, VFD current de- rate will not be greater than 10% and not exceed a rate of 1% current de-rate per 1°C or VFD must be oversized. VFD's that can operate at 40°C intermittently (during a 24-hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non- condensing. Enclosure shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable.
 - All VFD's shall have the following standard features:
 - All VFD's shall have the same digital keypad, shall be removable, capable of remote mounting and uploading and downloading of parameter settings for start-up of multiple VFD's.
 - The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes.
 - There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays, four (4) separate, independent timer functions that have both weekday and weekend settings.
 - The VFD's shall utilize pre-programmed HVAC application macro's specifically designed to facilitate start-up.
 - The VFD shall have cooling fans designed for replacement without requiring removing the VFD from the wall or removal of circuit boards.
 - The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without safety tripping or component damage (flying start).
 - The VFD shall automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal.
 - The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
 - The VFD shall have integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% impedance AC line reactors. VFD's with only one 5% DC reactor shall add AC line reactors.
 - The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
 - The VFD shall be capable of sensing a loss of load (broken belt/broken coupling) and signal a warning or fault as required.
 - If there is a loss of the input reference the VFD shall give the user the option of either(1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user.

- All VFD's shall have the following adjustments:
 - Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 - Two (2) PID set point controllers shall be standard in the drive, using the microprocessor for the closed loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. The PID parameter values may be changed with a digital input, serial communications or from the keypad. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain set point of an independent process (i.e. valves, dampers, cooling tower bypass valve control, chilled water valve control, etc.) and be accessible from the serial communication network. The set points shall be available in engineering units.
 - Two (2) programmable analog inputs shall accept current or voltage signals.
 - Two (2) programmable analog outputs. (0-20ma or 4-20ma)
 - Six (6) programmable digital inputs allowing multiple safeties run permissive circuits for damper and valve control, etc.
 - The VFD shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VFD or bypass mode). The VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VFD system safety interlock (fire detector, freezestat, high static pressure switch, etc.) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
 - Three (3) programmable digital Form-C relay outputs standard, expandable to (6). The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC or 250 VAC. Maximum voltage 30 VDC and 250 VAC with maximum continuous current rating 2 amps RMS. Outputs shall be true from C type contacts; open collector outputs are not acceptable.
 - Seven (7) programmable preset speeds.
 - The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.
 - The VFD shall reduce the carrier frequency on actual VFD temperature that allows highest carrier frequency without derating the VFD.
 - The VFD shall include password protection against parameter changes.
- The Keypad shall include a backlit LCD display be in complete English words for programming and fault diagnostics (alphanumeric codes are not acceptable).
- All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three selectable values will be displayed in real time, in complete English words.
- The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed.
- Serial Communications
 - VFD's shall use BACnet over MS/TP to communicate with the Pima Community College EMCS. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority, non-certified protocols are not allowed.
 - The BACnet connection shall be an RS485, MSTP interface operating at 9.6, 19.2, 38.4 or 76.8Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B- ASC). The interface

- shall support all BIBBS (BACnet Interoperability Building Blocks) defined by the BACnet standard profile for a B-ASC.
- The drive shall have the capability of allowing the DDC (Direct Digital Control/ Building Automation System) to monitor feedback, such as process variable feedback, output speed/ frequency, etc. monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information, remote VFD fault reset keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID set point, and the ability to force the unit to bypass(if bypass is specified) shall be transmitted over the serial communications bus. The DDC system shall also be able to monitor and start stop if the motor is running in the VFD mode or bypass mode. (If bypass mode is specified)
- The VFD shall allow the DDC to control the drive’s digital and analog, inputs and outputs. For example, the analog outputs may be used to modulating chilled water valves or cooling tower bypass valves, digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation.
- Drives shall be commanded via serial communications from EMCS controller. Separate connections/conductors used to tie into EMCS I/O shall not be used.
- EMI/RFI filters. All VFD’s shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level.
- Bypass – All features shall be UL listed by the drive manufacturer as a complete assembly and carry a UL508 label.
 - An output contactor, bypass, contactor and VFD only disconnect/service switch and/or fuses. Overload protection and shall be provided in both drive and bypass modes.
 - Door inter-locked, pad-lockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.
 - Fused VFD only disconnect (service switch) and/or fast acting fuses exclusive to the VFD to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs that incorporate fuses common to both the VFD and the bypass will not be accepted. Three contactor by pass schemes are not acceptable, as a VFD input contactor is not a NEC recognized, lockable, physical disconnect and is an unacceptable means of safely disconnecting power to VFD.
 - The drive/bypass shall provide single-phase motor protection and under-voltage protection in both the VFD and bypass modes.
 - The following operators shall be provided: a. Bypass Hand-Off Auto; b. Drive mode selector; c. Bypass mode selector; d. Bypass fault reset.
 - The following indicating lights (LED type/pilot light) shall be provided: A test mode or push to test feature shall be provided: a. Power-on (Ready); b. Run enable (safeties) open; c. Drive mode select damper opening; d. Bypass mode selected; e. Drive running; f. Bypass running; g. Drive fault; h. Bypass fault; i. Bypass H-O-A mode; j. Automatic transfer to bypass selected; k. Safety open; l. Damper open; m. Damper end-switch made.
 - The following relay (form C) outputs from the bypass shall be provided: a. System started; b. System running; c. Bypass override enabled; d. Drive fault; e. Bypass fault motor overload or underload (broken belt); f. Bypass H-O-A position.
 - Customer Interlock Terminal Strip for connection of freeze, fire, smoke contacts, and external start command. The remote start/stop contact shall operate in VFD and bypass modes.
 - Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure for fireman’s override. Two modes of operation are required.
 - One mode forces the motor to bypass operation.
 - The second fireman’s override mode remains as above but will also defeat all safeties and inputs (run until destruction).
 - Class 20 or 30 (selectable) electronic motor overload protection shall be included.

- Provide capability to select manual or automatic bypass.

Part 3- Execution

- Installation
 - Installation shall be the responsibility of the mechanical contractor as outlined in the installation manual.
 - The electrical contractor as outlined in the installation manual shall complete power wiring.
- Start-Up
 - Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and copy kept on file at the manufacturer.
- Product Support
 - Factory trained application engineering and service personnel shall be locally available at both the specifying and installation locations. A 24/365 (24 hour/ 365 days per year) technical support line shall be available on a toll-free line.
 - A computer based training CD and 4 hour on-site training shall include installation, programming, and operation of the VFD, bypass and serial communication.
- Warranty
 - Warranty shall be 24 months from the date of substantial completion. The warranty shall include all parts, labor, travel time and expenses. There shall be 24/365 support available via a toll free phone number.

End of Section 40 97 00