INTRODUCTION

Intent
These Pima County Facilities Management Design and Construction Standards are maintained by Pima County and are intended to serve as a resource for design professionals and contractors to facilitate the planning, design, and construction of Pima County facilities. They are intended to convey technical requirements for the design of new and renovated facilities and are to be used as applicable for each individual project. They contain information related to the design parameters, preferred materials of construction, and installation requirements that Pima County feels are appropriate to ensure a high degree of sustainability, quality, and long-term serviceability of new and renovation projects. The goal is to provide a comfortable, clean, safe, and functioning work environment for governmental services in an energy efficient and cost-effective manner. Any deviations from these standards when designing or constructing projects, are to be documented and prior approval granted by the PC Project Manager.

Organization
These Pima County Facilities Management Design and Construction Standards are organized in accordance with The Construction Specifications Institute (CSI) Master Format. Each applicable section must be reviewed as appropriate for each individual project.

Disclaimer
These Standards are not intended to be a substitute for specifications prepared by design professionals and do not relieve the consultants from their responsibility to exercise due care in design and documentation of Pima County Facilities Management projects in a manner consistent with accepted standards of professional practice.

Modifications
This document is intended to be an evolving resource, and Pima County encourages comments, suggestions, and proposed corrections/modifications from consultants, contractors, and other interested parties. Please email your comments to Sheila Holben, Deputy Director of Pima County Facilities Management at Sheila.Holben@pima.gov.
<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>Issuance Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division 01 - General Requirements</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 03 – Concrete</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 04 – Masonry</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 05 – Metals</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 06 – Woods, Plastics &amp; Composites</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 07 – Thermal Moisture Protection</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 08 – Openings</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 09 – Finishes</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 10 – Specialties</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 22 – Plumbing</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 23 – Heating, Ventilation &amp; Air Conditioning</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 26 – Electrical</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 27 – Communications</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 28 – Fire Alarm</td>
<td>September, 2022</td>
</tr>
<tr>
<td>Division 28 – Security Systems</td>
<td>September, 2022</td>
</tr>
<tr>
<td>General Commissioning Requirements</td>
<td>September, 2022</td>
</tr>
</tbody>
</table>
Division 01 – General Requirements

1. Alternates
   A. When required by the Pima county project manager, provide up to three “additive” alternates. Review alternates with Pima County to identify order of priority. Pima County Procurement requires alternates to be accepted in order to determine the low bid proposal, i.e., base bid, base bid plus alternate #1, base bid plus alternates #1 and #2, etc.
   B. Include a description of the alternates in the specifications and describe the base bid so that it is as clear as possible to the bidders.
   C. Include drawings of alternates and base bid conditions to clearly define both conditions to the bidders. Include drawings for all impacted disciplines.

2. Allowances
   A. Design-Bid-Build - Only provide allowances in bid projects if Pima County approves them.
   B. CMAR delivery method – Alternates and allowances shall be used to provide flexibility in developing the GMP. Define the alternates and/or allowance as much as possible.
   C. Define the amount of each allowance for items where the scope is less defined.

3. Summary
   A. Design Professional is to provide a description of Project with unique aspects including the following:
      1) Construction phases and sequencing.
      2) Access restrictions and requirements.
      3) Areas of work restrictions and requirements.
      4) Any special requirements for the hours of work.
      5) Occupied site information.
      6) Pima County Supplied, Contractor Installed or Pima County Supplied/Installed products or equipment.
      7) Any work “By Others”.

4. Project Management and Coordination
   A. Pima County to host and provide a web-based project management software (Procore) unless otherwise indicated by PCFM. If PCFM elects to have the Contractor host the project management software, then the Contractor shall use
Procore. The software system must be capable of managing, logging, and tracking the following aspects: RFIs, ASIs, change directives, cost proposals, change orders, drawing packages, payment applications, meeting minutes, photographic documentation, submittals etc. Provide unlimited user access for Pima County plus the consultant team members.

1) Acceptable software packages include: Procore.

B. If Contractor provides project management software, then upon completion of the Project the Contractor shall provide an archived copy of the Project Website files to the Pima County and Architect in a digital storage format acceptable to the Pima County.

C. Construction Progress Documentation
   1) Require Contractor to maintain a digital as-built construction set updated to note field conditions, RFIs, ASIs, field dimensions and any other changes to the construction documents. These documents shall be updated monthly and stored to Procore.

   2) Review of the as-built progress will occur monthly at the time of submission of the application for payment.

5. Coordination and Meetings

A. Pre-construction Meeting
   1) Pima County will schedule the pre-construction meeting.

   2) Meeting will include a review of the scope of work, details of the work, phases, Pima County requirements, etc. to establish the procedures and details of the Construction Contract.

   3) Designation of all personnel representing all parties including but not limited to the Contractor, Architect, Pima County, materials testing, building and utility permit inspections, Cx, other Pima County provided vendors, etc.

   4) Define requirements on Progress Meeting notes and distribution responsibility.

   5) Review of project management software including training requirements.

B. Progress Meetings (OAC)
   1) Provide information on frequency of meetings, typically weekly, based on the project scope and complexity.

   2) Define responsible party for taking and distributing the meeting minutes.
      b. CMAR: General Contractor.

   3) Electronic version of working as-builts shall be reviewed by Pima County and the Architect on a monthly basis when submitting the draft of the payment application.
C. Pre-installation Meetings

1) Specification sections shall require pre-installation meetings for trades that are complex, interface with other trades, require a high level of coordination, trades that provide an exposed finish, etc. All finish trades require a pre-installation meeting. All special systems require a pre-installation meeting.

2) Contractor shall establish the date of the meetings, invite all required participants as defined by Pima County including design consultants and Pima County, lead the meeting, record, and distribute the meeting minutes.

3) Contractor shall provide at least 3 working days advance notice of the pre-installation meetings.

6. Schedule

A. Contractor shall provide a Critical Path Method (CPM) Schedule to Pima County within 14 calendar days of receiving the Notice to Proceed.

B. The CPM Schedule shall be prepared using a program that has been developed specifically for Construction Management. The schedule and associated network diagram shall show the sequence and interdependence of activities required for complete performance of all items of work identified by the Contract, in the time frame allowed by the Contract.

C. The CPM Schedule shall have no tasks with a duration greater than 10 working days unless approved by Pima County.

D. The CPM Schedule shall include all major milestones including phases, punch list reviews, final cleaning, certificate(s) of occupancy, final completion, permit inspections, mockups, demobilization, furniture installation, Pima County shop/vendor scope, etc. based on consecutive calendar days.

1) The Contractor shall include all Pima County coordination tasks in the Schedule:
   a. Pima County provided Pima County installed equipment and furniture.
   b. Pima County provided Contractor installed equipment.
   c. PCFM shop observations of underground, wall, and ceiling infrastructure.
   d. Special inspections on the critical path.
   e. Consultant/engineer observations.
   f. Pre-installation meetings on the schedule.

2) Identify utility interruptions with sufficient Pima County notification, typically 72 hours.

3) Startup of systems including HVAC, elevators, life-safety systems, etc.
4) The CPM Schedule shall include weather days estimated by the Contractor based upon historical data such as NOAA for the time of year during which the specific construction activities shall occur. Review and approval of the total days shall be required by the Pima County. Once established, additional weather delays will be an excusable delay per the Contract.

5) Include holidays during the contract duration.

E. The Contractor shall coordinate the CPM Schedule with Submittal Schedule and Procurement activities longer than 20 days. Procurement activities include submittals, approvals, shop drawings, mockups, purchasing, fabrication, and delivery.

1) See Submittal Procedures section for submittal schedule requirements.

2) Include deferred submittals/delegated design items such as fire sprinkler, fire alarm, prefab trusses, etc.

F. CPM Schedule Updates

1) The CPM Schedule shall be updated weekly showing actual construction progress and identify changes to tasks, start/finish dates, durations, the Critical Path, float, and approved Contract time adjustments. Updates to the CPM Schedule should be hosted or available through the project management software.

2) The CPM Schedule update shall be provided 24 hours prior to the weekly construction meeting to allow for review before the meeting.

7. Reference Standards

A. Provide a list of applicable building codes.

B. Provide reference standards for all trades and work required.

8. Product Requirements

A. Product selections shall be from the Pima County Design Standards. Where a specific product is not provided in the Pima County Design Standards, the consultant shall review the specified product with Pima County for approval and inclusion in the project. While it is encouraged to provide multiple products/manufacturers, there are specific items where a single product/manufacturer is necessary to ensure quality, the ability for Pima County to maintain the product or system and to allow connectivity to an existing building system, fire alarm, access control or energy management control systems.

B. For a specified manufacturer and product, more than one shall be listed unless approved by Pima County’s Project Manager or listed in Pima County’s Design Standards as a “no substitution”. If additional manufacturers or products are acceptable other than those listed the “Products” section of the specification shall call out “Prior Approval” in lieu of “Approved Equal”. See below for further requirements.
C. Basis-of-Design: For basis-of-design products, a list of multiple manufacturers and their product/s shall be provided. The list of manufacturers and products shall be vetted by the design professional to verify that the manufacturer’s product is acceptable to Pima County.

D. Sole-Source: Where there is not an equal manufacturer/product, then the product shall be listed without “or approved equal” but include “prior approval” language.

E. Prior Approval: It is preferred that “prior approval” be used for equipment such as pumps, HVAC, or any complex/specialty equipment to limit the number of requests and evaluation processes during the construction submittal phase of the project. This is critical for design-bid-build delivery projects. Prior Approval must be made before bids are due and must be processed through a request by the Contractor to the Pima County Procurement Department, as described in the bidding documents.

F. Pima County’s Procurement Department will provide the forms and requirements for the “prior approval” process. The design consultant will provide the evaluation of a prior approval when submitted by bidders.

G. Approved Equal: Approved equal shall be limited in its use. Where a standard construction product is specified and “approved equal” is included, the specification shall list the specifics and details of the “basis-of-design” product to clearly describe the product and its quality. The goal is to limit the use of a lesser quality product or a product that does not meet the performance requirements of the “basis-of-design” product and to reduce the time required to evaluate a product during the construction phase. Approved equal products shall be vetted for impacts to other scopes, including structural engineering and sound mitigation.

9. Submittal Procedures

A. Require Contractor to use project management software for all submittal distribution and management.

B. Contractor shall develop a submittal schedule, within 14 days of the notice to proceed, with all required submittals, samples, mockups, etc. including long lead items and issue to Pima County for review. The schedule shall be updated throughout the project.

C. All submittals shall be in electronic format, submitted as an unlocked PDF. Hardcopy submittals will not be accepted.

D. Allow 14 days for each submittal review including a 7-day second review. Contractor shall issue each submittal with the appropriate time required for two (2) reviews. Expedited review must be approved by Pima County ahead of submittal.

E. Submittals shall be labeled by specification section and with a subset number for revisions.

F. All submittals shall be reviewed by the Contractor prior to submitting to the Architect/Pima County and stamped, signed, and dated identifying their review. Contractor shall reject submittals that do not generally conform to specifications.
G. Physical samples are required for finishes, but electronic submittals must be included in the project management software for tracking purposes. Provide photos of the products and submit the physical samples to the project team.

H. Mock-ups shall be required for specialty work or where a specific finish needs to be reviewed. Mockups are encouraged to be completed in place if acceptable to Pima County and the Architect. The Architect shall review with the Pima County and provide comments via the submittal process.

I. Submittals shall identify all changes.

10. Field Engineering

A. Contractor shall provide field engineering services and utilize recognized engineering survey practices. Working from existing or Pima County established reference points, establish and maintain benchmarks and other dependable markers and set lines and levels for the work at each story of construction and elsewhere on site as needed to properly locate each element of entire project. Calculate and measure required dimensions as shown within recognized tolerances. Advise tradesmen performing the work of the marked lines and levels provided for their use in layout of work.

B. Notify Architect immediately of any discrepancies identified.

11. Contract Modification Procedures

A. Proposal Requests (PR)
   1. Contractor shall provide a quotation of cost for the work described in the proposal request within 5 working days after receipt of the document.

B. Change Order Requests (COR)
   1. Contractor shall provide a quotation of cost within 5 working days of identifying the change to the work or issued documentation to provide a quote.
   2. Provide a statement indicating the reasons for the change, with the date identified and effect of the change to the work as shown in the contract documents or reference the proposal request or RFI that the change is based on.
   3. The quotation shall include a breakdown with the list of material quantities with unit costs, labor breakdown with labor rates, supervision costs, equipment rentals, etc. to complete the work.
   4. The quotation shall include applicable taxes, bond, insurance, profit, and overhead (allowed by contract) both in amount and percentage.
   5. Provide a breakdown of credits for any work not required based on the change.
   6. Include an updated schedule that indicates the effect of the change in work to the critical path of the schedule.
C. Contingency/Allowance Use Documents
   1. Any contingency or allowance use request shall include a breakdown with the list of material quantities with unit costs, labor breakdown with labor rates, supervision costs, equipment rentals, etc. to complete the work.
   2. All contingency or allowance use requests shall be reviewed and approved by both the Architect and Pima County.

12. Temporary Facilities and Controls
   A. Contractor shall provide a common use field office.
      1. The conditioned field office shall provide enough space for on-site staff, a meeting space for 10 people, space for a Pima County representative and Architect to work periodically. This requirement may vary depending on the size, location, and scope of the project.
   B. Portable toilets shall be required for construction personnel. Construction personnel shall not use any existing restrooms on site.
   C. Security fencing in the form of temporary chain-link construction fencing shall be provided on all projects unless directed otherwise.
   D. Signage shall be provided for site access, project identification, safety, address, and any other necessary information related to the construction activities.
   E. Safety measures are required where a project is adjacent or near occupied sites. These measures are project/site specific, and the specifications shall include the requirements to protect the public and County employees.
      1. Fencing, barriers, etc.
      2. Signage indicating authorized access, wayfinding, and directional assistance, etc.
      3. Gates or other controlled access points.
      4. Monitored access points or locations.
      5. Security personnel if required.
      7. Traffic control measures.
      8. Provide drawings to support safety measures required.
   F. Contractor shall pay for all temporary utilities during construction. Pima County to take over utilities at substantial completion.
      1. In the event of existing utilities with service in Pima County’s name, coordinate requirements with the Pima County project manager.

13. Closeout Procedures
   A. Punch list requirements:
      1. Contractor to provide a list of incomplete items prior to requesting the Architect to perform the punch list. The list shall only include items that are minor in nature and that can be completed within a week of the punch list review.
2. Contractor to provide a final approval from authorities having jurisdiction with all inspections complete. Documentation of closed permit is required from Contractor.

3. Final building cleaning.
   a. Require all cleaning materials to comply with Green Seals GS-37.
   B. Require all training to be scheduled and performed with Pima County.
   C. Turn over all materials, attic stock, etc. to Pima County.

14. Operations and Maintenance Manuals
   A. Provide general contractor’s and sub-contractor’s two (2) year warranty from date of substantial completion, including instruction for initiating and tracking warranty issues through Contractor.
   B. Organize with tabs and a table of contents.
   C. Provide list with contact information of all subcontractors.
   D. Provide operation and maintenance data for components and systems for the project.
   E. Provide emergency information and procedures.
   F. Submit the Operations and Maintenance Manual by section for review thru the Project management software.
      1. Separate into sections by trade for review, comment, and approval.
   G. After approval of the submittal is received, submit one (1) hardcopy and a digital PDF to Pima County.

15. Project Record Documents
   A. Electronic version of working as-builts shall be reviewed by the Pima County and the Architect at the time of payment application each month.
   B. Contractor shall submit project as-builts to the Architect and Pima County for review and approval prior to substantial completion.
   C. As-builts shall provide a record of all RFIs, ASIs, field located items, field changes and any other important information to supplement the as-builts.

16. Demonstration and Training
   A. Provide training for equipment as required for each specification section.
   B. All training shall be conducted by skilled trades people capable of working on and troubleshooting the system.
   C. For complex and/or unique systems provide a hi-definition video recording of the training provided to the Pima County personnel.
   D. Coordinate training with Operations and Maintenance data submittals.
17. Attic Stock

A. Attic stock shall be required for materials unique to the project with quantities described in the specifications.

B. Do not require attic stock for standard construction materials; lamps, paint, filters, etc.

C. Review items and quantities with Pima County before including in the specifications.
**Division 03 - Concrete**

1. **Concrete**

   A. Material testing to be performed by a Qualified Consultant from Pima County’s Qualified Consultant List (QCL). Special inspections to be performed by the engineer of record or the Qualified Consultant. Pima County Facilities Management to contract and pay for material testing and special inspection.

   B. An under slab vapor barrier shall be specified to minimize moisture transmission through the slab. It shall not be located directly under the slab. Vapor barriers shall meet the requirements of Class A Standard 10ml moisture barrier.

   C. All sawcutting and pour backs shall be epoxied and doweled.

   D. 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.

   E. Exposed architectural concrete/specialty finished floors shall be densified and appropriately sealed.

   F. An appropriate sealer shall be used based on the need of the building and the building usage type with future maintenance upkeep in mind.

   G. The design professional shall review interior concrete floor finish to be compatible with general maintenance.

   H. Mock-ups for special finishes 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.
Division 04 - Masonry

1. Masonry
   A. All exterior masonry shall have a penetrating sealer applied equal to Blok-Lok, silane/siloxane.
   B. Depending on project location, an anti-graffiti coating may be required. Pima County Facilities Management and the design professional to determine requirement and type specified i.e. sacrificial vs. non-sacrificial. Prosoco Blok-Guard and Graffiti Control Ultra.
   C. Burnished block is not allowed.
   D. Masonry mock-ups shall be required for exposed block and/or specialty finishes. Mock-ups may be incorporated into the final work. Mock-ups to be approved a minimum of 48 hours prior to start of work. Color substitutions in mock-up due to availability will not be accepted without approval.
   E. The type of mortar joint should be specified. Tooled joints are preferred. Raked and flush joints are discouraged.
   F. The tops of all exposed masonry walls shall receive a watertight cap.
   G. The backside of parapets must be coated with a cementitious product equal to Thoroseal/Tamoseal.
   H. No high pressure hose washes are allowed. Contractor shall clean masonry with a low pressure wash with a cleaning solution and/or a polymeric or stainless-steel brush.
Division 05 - Metals

1. Cold Formed Metal Framing
   A. Provide minimum 33 mil steel studs at metal framing with double studs at door jambs.
   B. Design professional to determine required sizes for project conditions.
   C. Pony walls/wing walls must be properly anchored to a wall and designed to eliminate racking. Drawings should indicate where and what method pony wall anchoring shall take place.

2. Ornamental Metals
   A. Be mindful of exterior handrails/door pulls due to extreme Southern Arizona temperatures. Color should be selected with heat gain in mind.

3. Metal Decking
   A. No attachments directly to the underside of the metal decking. The only exception is with concrete filled decking.
   B. Verify that metal deck priming or galvanizing is compatible with fireproofing when applicable.
   C. At exposed metal deck, consideration shall be given to the visual appearance of the exposed fasteners (pattern).

4. Metal Fabrications
   A. This section applies to all miscellaneous metal items such as lintels, embeds, grating, ladders, handrails, stairs, bollards, nosings, trim and similar architectural features.
   B. Grout and anchoring cement shall be non-metallic, non-shrink type.
   C. Welds shall be ground and sanded smooth for uniform painted appearance. The use of “Bondo” to fill large gaps and holes is not permitted.
   D. All sharp corners shall be radius a minimum of 1/8”.
   E. The use of expansion bolts to secure metal railing assemblies is not permitted. Anchorage shall consist of direct embeds (cored holes, sleeves or plates) and/or welding.
Division 06 – Woods, Plastics & Composites

1. Rough Carpentry
   A. Forest Stewardship Council (FSC) wood is required for LEED projects.
   B. To avoid termite infestation, no wood stud walls are allowed. The only exception is for minor wall infill at existing wood walls, or when prior approval is granted by the PCFM Project Manager.
   C. Provide solid blocking at all unsupported edges of roof deck sheathing.
   D. Pressure treated wood shall be used when in contact with roofing and/or concrete.
   E. No OSB is to be used at roof or wall sheathings. Roof sheathing shall be a minimum of 5/8” thick, Structural 1 Exterior Plywood over trusses or joists at 16” or 24” spacing. At 24” spacing, “ply clips” shall be required.
   F. Indicate and coordinate on all plans and specifications all required solid blocking at all wall hung fixtures, door stops, cabinets, shelves, and similar items.

2. Finish Carpentry/ Interior Architectural Woodwork/Custom Casework
   A. FSC wood is required for LEED projects.
   B. No endangered tropical hardwoods may be used except for cases of historic building rehabilitation to match existing wood per Arizona Revised Statutes. Endangered tropical hardwoods include ebony, luan mahogany and teak.
   C. All architectural woodwork shall be “Custom” grade or better (particle board/particle board core plywood is not allowed). Plywood shall be industrial quality.
   D. Durable high quality architectural woodwork (millwork) shall be used.
   E. Plastic Laminate – low pressure laminate, “Melamine” type laminate is acceptable ONLY for concealed shelving.
   F. Counter Top/Underlayment – Provide minimum ¾” plywood, 7 ply plywood or underlayment at all counter tops. Exterior grade plywood at all sink locations.
   G. Medium density fiber board (MDF) may be used for wood veneer doors and drawer fronts.
   H. Plywood shall be all hardwood veneer core. Alternatives may be allowed on a case-by-case basis as approved by the Project Manager.
I. 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”.

J. Hardware shall be indicated in a schedule in the same specification section as cabinetry.

K. Plastic laminate counter tops and back splashes are to be fabricated using ¾” plywood unless approved otherwise. Edges and joints shall be tight, glued and sealed. Post formed tops and splashes are not allowed. High pressure laminate only.

L. Solid Surface counter tops to be provided at all wet locations and high usage areas like reception desks in public spaces.

M. 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.

N. Fabricate case bodies with top dadoes if transparent finish.

O. All “custom” grade millwork concealed scribed and cut surfaces shall be treated with 50% Pentachlorophenol solution in a 1:10 mixture with deodorized spray base.

P. Drawers – Provide ½” minimum plywood for front, sides, and back of all drawer construction. Provide minimum of ¼” plywood or 7 ply plywood for all drawer bottoms.

3. Exterior Wood

A. FSC wood is required for LEED projects.

B. Exposed wood on the exterior is subject to the Project Manager’s approval. Approval dependent on evidence of response to exposure concerns of wood in the desert related to species and finish.
Division 07 - Thermal & Moisture Protection

1. **Subgrade Waterproofing**
   A. Refer to the “Concrete” section for under slab vapor barrier requirements.
   B. The Design professional will review subgrade water proofing and foundation drainage system with the project manager.

2. **Building Insulation**
   A. Must use a scrim or craft paper for exposed insulation.

3. **Roof Design**
   A. It is preferred that duct runs on the roof be minimized.
   B. Prefabricated roof curbs for equipment mounting is required.
   C. Concealed drainage systems are not preferred.
   D. Minimize use of exposed conduit and piping installed on top of the roof.
   E. Design must meet OSHA workplace and fall protection criteria.
   F. Provide permanent and secure access to all roofs. Roof access shall meet OSHA guidelines.
   G. Roof shall be designed to direct drainage away from entries.
   H. Ensure that the design makes adequate allowance for proper flashing of perimeters and penetrations. Sufficient vertical dimension to install the cant strip, base flashing, counterflashing, and coping, will result in a parapet at least 18” above the finished roof at the highest point of the roof slope.
   I. Design all roof drains and overflow drains in a depressed sump.

4. **Built-Up Bituminous Roofing**
   A. Modified SBS roofing, 3 ply with mineral capsheet with minimum 15 year warranty and high SRI value is required.
      1) Johns Mansville.
      2) Firestone.
      3) Siplast.
   B. All Built-Up Bituminous Roofing shall have a minimum slope of 1/2” – 3/8” per foot.
C. 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.

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

E. Provide traffic walk pads around all roof top equipment requiring maintenance and at all designated entry points on the roof as determined by the PCFM Project Manager. Specify pads compatible with the roofing.

5. Below Grade Spaces
   A. Drainage systems and wall waterproofing are required at all below grade spaces. Refer to Geotech recommendations.

   A. The use of stucco and Exterior Insulation Finishing Systems (EIFS) systems are not preferred.

7. Preformed Roof and Wall Panels
   A. No exposed fastener metal roofing is permitted. The only metal roofing allowed is high slope (greater than 3:12) standing seam roofing with watertight seam designs. Equipment that must be serviced (such as HVAC equipment) is not allowed on metal roofs and must be located on the ground or sidewall mounted.

8. Flashing and Sheet Metal
   A. During product selection, keep in mind issues with oil canning.
   B. 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 building.
   C. Wherever possible, avoid reliance on sealants as the sole means of prohibiting entrance of water.
   D. 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.
   E. 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.”
   F. Specify minimum 24 gauge thickness for galvanized metal and identify specific heavier gauges where the project requires.
G. Do not specify roof jacks or boots which utilize integral neoprene seals.
H. Use only galvanized structural steel tube or pipe for downspout sections which are subject to impact and abuse.
I. Specify only 50/50 tin/lead solder when applicable.
J. Specify only non-corrosive fasteners, same material as metal being fastened, with matching finish on exposed heads. Specify neoprene-backed washers for screw fasteners.
K. Specifically describe requirements for expansion and contractions joints, and for sealing joints in running flashings. Do not rely on generic “provide expansion joints as required” notes.
L. Specifically design joints to allow for removal and reinstallation of flashings during re-roofing. Two-piece reglets are preferred.
M. Specifically describe requirements for separating dissimilar metals.

9. Roof Specialties and Accessories
   A. 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 counterflashing. Where roof accessories are not ordinarily curbed, specify and detail custom shop fabricated sheet metal curbs. Avoid as much as possible accessory units which rely on flat flanges to permit secure application of roof membrane.

10. Skylights
    A. 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. Must meet OSHA fall requirements.

11. Sealants
    A. Adhesion field test may be required on a case-by-case basis.
    B. 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.
    C. Pay particular attention in sealant system design to expected joint movement, joint dimensions (including specified minimum and maximum dimensions) sealant position (horizontal, vertical, or overhanging), and potential for physical abuse of the sealed joint.
    D. Specifically describe and detail on the drawings all joints requiring installation of sealants. Generic notes such as “sealant as required” are not acceptable.
E. Specify each particular type of sealant and sealant system required, including primers, backers, fillers and colors. Specifically prohibit the use of latex and butyl sealants and specify non-staining materials.

F. Provide a sealant schedule identifying location and type of sealant. Specifically require sealants to be installed in accordance with the manufacturer’s recommendations. Include color for each location, do not use custom colors.
Division 08 - Openings

1. Doors
   A. Use medium or wide stile doors.

2. Frames
   A. No knock down frame type allowed, use fully welded hollow metal frames.
   B. Specify any specialty prep for future access control when necessary.

3. Hardware
   A. Locksets.
      2) Sargent – 8200 Series.
      3) Schlage – ND Series.
      4) No IC cores.
      5) Match existing building’s hardware if a renovation or addition.
      6) Heavy Duty.
   B. Use heavy duty hinges.
   C. Closures.
      1) Corbin Russwin, LCN or Sargent.
      2) Surface preferred.
      3) Provide hold opens as required for the space.
   D. Provide door and wall protection.
      1) Wall Stops preferred over floor stops.
   E. Contractor to assume supply of construction cores, PC lock shop will key after substantial completion.

4. Automatic Door Operators
   A. Provide automatic door operators at all public entries. Nabco or LCN.
   B. Specifications to require a door hardware review meeting with Pima County, Contractor, and Door Hardware supplier to review schedule prior to submittal.
Division 09 - Finishes

1. General
   A. Pima County Project Manager will provide standard material finish requirements for carpet, tile, solid surface, plastic laminate, etc. Any alternate finish selections must be approved by the County Project Manager.

2. Gypsum Board Assemblies
   A. Gypsum board used on walls and ceilings shall be 5/8" Type “X” gypsum wall board.
   B. Describe locations for all expansion joints in gypsum board walls and ceilings on the drawings. When possible, indicate on interior elevations for clarity.

3. Metal Support Systems
   A. Provide blocking at points of attachment for small fixtures, toilet accessories and partitions, handrails, door stops, etc. Blocking shall be 2x6 minimum fire retardant treated wood blocking or 6" wide 33ml minimum gauge (sheet metal gauge) galvanized sheet metal with a minimum thickness of 0.0356" (0.0400" nominal).
   B. All cold formed steel shall comply with SSMA.
   C. Prescribe all studs to be minimum 20 gauge (steel stud gauge) with minimum wall thickness of 0.0300" (30 mls). Locate studs at 16" on center including soffit framing.
   D. 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.
   E. 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 caulkling.
   F. Specify framing intersections and special conditions as follow:
      1) Three studs or floating studs at corners.
      2) Double 20-gauge studs at door jambs and each side of openings and end of wall terminations.
      3) Double studs both sides of expansion joints.
      4) Floating stud (slip track) at ceiling conditions where deflection is anticipated.
      5) Provide double studs at all door openings with studs secured together on both sides.
6) Intermediate bracing located at midspan for wall heights exceeding 12’. For walls greater than 12’ intermediate bracing shall be placed at 6’ on center vertically. Provide minimum ¾” cold rolled channel bridging with clips at each stud.

7) Specify blocking and attachment devices to be provided where shelves or casework are installed.

8) 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.

4. Acoustical Tile Ceilings
   A. Ceilings shall be 2’ x 4’ lay-in panels, Armstrong Cirrus Second Look.
   B. Technical characteristics shall generally comply with the following:
      1) Color/Light Reflectance White/LR not less than 0.75
      2) Noise Reduction Coefficient NRC not less than 0.70
      3) Ceiling Attenuation Class CAC not less than 35
   C. Grid shall be heavy duty.

5. Acoustical Wall Insulation
   A. Provide full height acoustical sound batt insulation, drywall, and acoustical caulk around all perimeter edges for offices, conference rooms and restrooms. Any additional sound requirements will be addressed on a case-by-case basis.

6. Painting (Professional Line Products)
   A. Factory primed hollow metal shall be primed and finished with a Direct to Metal Paint (DTM). There are some exceptions to metal.
   B. No “flat” interior wall paint – specify “EGGSHELL”, “SATIN” or “SEMI-GLOSS”. Flat ceiling paint will be at the PCFM Project Manager’s discretion.
   C. No solvent-based paint to be specified without prior approval of PCFM.
   D. All walls shall have a primer coat using a PVA primer product that is tinted with a color as close as possible to the final wall color.
   E. All painted walls shall have two final coats minimum to achieve full coverage.
   F. Concrete floors shall have a clear seal finish. For colored concrete floors, use a stain before the clear seal finish.
   G. Production grade materials are not allowed. Interior and exterior paint shall be 100% acrylic.
Division 10 - Specialties

1. Bathroom/Breakroom Accessories (Pima County Furnished Contractor Installed)
   A. Include and document the following accessories at restrooms, breakrooms, or other areas with sinks unless there is a specific reason to deviate from the standard products. Consult the Project Manager if there are deviations from the standard. All accessories are to be installed by the contractor. Coordinate with Pima County Project Manager whether the accessories are owner provided or contractor provided. Document backing as required.
      1) Paper Towel Dispenser – Georgia Pacific Vista Universal Towel Dispenser (Waxie #54338).
      2) Toilet Paper Dispenser
         a. Public Restrooms or high use – Kimberly-Clark Jumbo Roll (Waxie #09507).
         b. Staff Restrooms or low use – Kimberly-Clark Professional Coreless Double Roll Tissue Dispenser (Waxie #09604).
      3) Soap Dispenser – Kimberly Clark (Waxie #92145).
      4) Toilet Seat Cover Dispenser – Plastic Smoke color (Waxie #851585).
      5) Sanitary Napkin Waste Receptacle – Floor mounted by Owner.
      6) Hand Dryer – Dyson Airblade V where appropriate. Do not use in single occupancy restrooms adjacent to staff areas or other areas where noise is a concern.

2. Fire Extinguisher Cabinets
   A. Recessed or semi-recessed non-locking cabinets with safety glass, stainless steel, or polyester paint finish capable of holding a standard 10-pound fire extinguisher.
   B. Include additional fire extinguishers in hazardous locations.
   C. Provide signage on wall above the cabinet where not clearly visible or partially obstructed.
   D. Provide locking type for high traffic public areas in consultation with the County’s Project Manager.
3. Signage
   A. 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.
   B. It is recommended that signage development be initiated early in the design of the project.
   C. All exterior signage must be reviewed and approved by Project Manager.
Division 22 - Plumbing - Design Requirements

1. General Requirements
   A. Piping, and conduit runs on rooftops shall be allowed at PCFM’s discretion only where necessary to meet a particular code requirement in an application specific installation.
   B. Piping shall not be directly embedded in concrete or masonry.
   C. Shut-off valves shall be accessible by an 8-foot step ladder, not be installed greater than 12 inches above the bottom of an exposed ceiling, and not greater than 10 feet above finished floor.
   D. All equipment shall have adequate maintenance access as required by plumbing and electrical codes and recommended by the equipment manufacturer.
   E. No garbage disposal shall be installed for break room or similar type applications. Disposals are permitted for medical examiner and commercial kitchen use. PCFM shall determine special applications in which garbage disposals may be installed.
   F. Extend vertical piping sleeves for penetrations 1” above floor for wet areas.
   G. Roof mounted piping shall utilize C-Port or Mifab Rubber supports.
   H. Piping and accessories used in potable water distribution shall comply with NSF 14, NSF 61, and NSF 372.
   I. For telecommunications room and closet prohibitions on piping routing, refer to Pima County Communications Infrastructure Design and Construction Standards.

2. Site
   A. All site backflow preventers shall be of the reduced pressure backflow preventer type.
   B. The inlet and outlet size of a backflow preventer installed on a service main shall be equal to the service line size from the utility meter.
   C. Site design for critical applications as determined by Pima County shall include a redundant backflow preventer in parallel operation with the primary backflow preventer.
   D. All underground utility piping shall have a tracing wire that is electrically continuous 14TW AWG wrapped around or buried alongside the pipe. Tracer wire shall be terminated at either end with 3 feet of coiled wire.
   E. All piping penetrating concrete shall be sleeved. Pipe sleeves installed below ground through exterior walls shall have mechanical type neoprene seals.
F. Below grade domestic water service mains from the backflow preventer outlet 3 inches or smaller may be Schedule 80 PVC. Domestic water service mains from the backflow preventer outlet greater than 3 inches may be C-900 PVC or ductile iron.

G. Below grade water piping shall be bedded in a minimum of 6 inches of bedding material with a 14-gauge tracer wire and backfilled with a minimum of 6 inches of shading material followed by marking tape.

H. Galvanized steel piping is NOT to be used for any domestic water piping application.

I. Install a wye-strainer upstream of each backflow device.

J. Backflow preventers exposed to weather shall be insulated and jacketed.

K. Backflow preventers in non-secured areas of a site shall be enclosed with a secure vandal-resistant cover.

L. Maintain minimum ¼” per foot slope on all site sanitary piping runs.

M. Two-way, double access point grade cleanouts of the “bull horn” type shall be utilized to allow access to entire section of piping. Cleanouts that do not provide access to entire piping section are not permitted. Tee or baffle type cleanouts are not permitted.

3. Restrooms

A. Fixtures:
   1) All urinals shall be of the waterless type.
   2) Urinals shall not have copper stub outs or any copper DWV piping within 10 feet of the fixture connection.
   3) Water Closets shall be either floor-mounted floor-outlet or floor-mounted wall-outlet unless replacing an existing wall-mounted type.

B. Accessories:
   1) Where men’s and women’s restrooms adjoin each other, valves and accessories requiring access shall be located on the men’s restroom side.

4. Break Rooms, Conference Rooms, General Purpose Areas

A. Where an ice machine is provided, a floor sink shall also be provided.

B. Where a sink may be used for arts, crafts, or similar type functions a sediment trap shall be located below the sink.

5. Equipment

A. Where water meters are installed on make-up lines serving equipment, an isolation valve, backflow preventer, a wye strainer, and spring-loaded check valve shall be installed upstream of the water connection to the equipment.
B. Where natural gas service exists to a site a gas water heater shall be installed.
   1) Exception: A variance shall be requested in writing to PCFM to install an electric water heater when minimal load requirements would make a gas water not cost effective when comparing the construction cost impact versus gas costs over time.

6. Utility Access
   A. Where utilities are located in a chase, a minimum 42-inch wide door shall be provided for entrance.
   B. Utility chases containing plumbing piping shall be no less than 48-inches wide.

7. Exterior Systems
   A. Hose bibbs installed in walls shall be of the wall hydrant (wall box) variety with a keyed cover. Where freeze protection is a concern wall hydrants shall be of the freezeless type. Wall depth shall accommodate the 7-3/8 inch minimum installation depth that is measured from front face of exterior wall to the outside elbow of a close-coupled installation in length such that the piping and wall hydrant are not exposed in the interior space.
   B. Where equipment requiring ongoing maintenance is installed on rooftops, a freeze proof hose bibb within 50 feet of equipment for cleaning purposes shall be provided.

8. Water Systems
   A. No water piping shall be installed below floor slab. Service entrance shall be through exterior wall above grade.
   B. All water meters shall be installed with a reduced pressure backflow preventer, including ¼ turn isolation valves, unions, and a wye-strainer. The wye-strainer shall be installed up stream of the backflow preventer assembly.
   C. Makeup water meters to individual systems shall have wye strainer and check valve included within the meter assembly.
   D. Support piping with hangers, trapeze, framing supports, or stands at maximum spacing as outlined within the International Plumbing Code (IPC). Utilize insulation inserts as appropriate to prevent the crushing of insulation or compromise of vapor barrier for cold conveyance applications.
   E. Install piping at right angles or parallel to building walls to the greatest extent as possible. Piping shall be installed to permit the servicing of valves and components and install free of sags and bends.
   F. No reverse osmosis water purification systems shall be installed for break rooms, lunchrooms, or office type applications. Where reverse osmosis systems are required for laboratory or other special need applications, final determination of water purification system type shall be made by PCFM.
   G. For roof mounted HVAC equipment, provide a ¾” water line terminating at a freezeless type hose bib within 50 feet of equipment. For ground mounted equipment provide a lockable wall hydrant within 25 feet.
H. Galvanized steel piping is NOT to be used for any domestic water piping application.

I. Install pipe escutcheons for piping penetrating walls, ceilings, and finished floors. ID to closely fit around pipe, tube, and insulation of piping with OD that completely covers opening.

J. Provide domestic water shutoff valves to isolate restrooms to allow for repair and maintenance without shutting down adjacent restrooms.

K. Provide shutoff valves to isolate plumbing fixtures to allow for repair and maintenance without shutting down larges sections of the plumbing distribution system.

L. All mechanical insulation installed indoors shall maintain a flame spread index of 25 or less and a smoke developed index of 50 or less as determined by testing in accordance with ASTM E84.

M. PCFM shall have the option to witness all piping system flushing, cleaning, and pressure testing.

N. As the wall thickness of Cross-Linked Polyethylene (PEX) piping is thicker than standard metallic piping, the inner diameter shall be used for water piping calculations. Upsize the designed diameter to account for wall thickness as appropriate. If the decision to utilize PEX is left to the installing Contractor, the design professional shall make this requirement to upsize clear.

O. If PEX piping is utilized, compression rings are to be utilized. No crimped type connections are to be use for PEX applications.

P. The use of Viega Press Fittings is permitted for chilled water and domestic water applications. Push-on type connections are NOT permitted for use.

Q. Cooling tower makeup water piping exposed to freezing conditions is to be heat traced and insulated.

R. All new construction and renovation design shall include a central domestic hot water system.

1) Where an existing central hot water system exists “insta-hot” type water heating devices shall NOT be installed.

2) Where domestic hot water is required, and a central system is not cost effective, a 5-gallon point-of-use water heater may be installed.

S. Water Hammer Arrestors (Shock Absorbers):

1) Water hammer arrestors installed in walls shall have a minimum 12-inch x 12-inch access panel.

2) Water hammer arrestors installed above gyp ceilings shall have minimum 18-inch x 18-inch access panel.

3) Access to water hammer arrestors installed above ceilings shall not be infringed upon by equipment of other trades or the ceiling structure itself.
4) Water hammer arrestors installed in adjoining Men’s/Women’s restrooms shall be accessible from the Men’s restroom.

9. Sanitary Waste and Rainwater Systems
   A. Urinal drain stub-outs shall not be copper.
   B. Trap guards are to be utilized in lieu of a trap priming system.
   C. Rainwater piping installed overhead where space temperature may cause condensation shall be insulated per Division 22 – Plumbing Products.
   D. Where both a primary and overflow downspout are located, the overflow downspout shall be vertically aligned above the primary downspout.
      1.) Exception: Where primary and overflow downspouts are located side by side they shall be located at the same elevation with weather resistant signage indicating which downspout serves the overflow roof drain per Section IX.E below.
   E. Where only an overflow downspout exists (or is designed as part of a replacement, remodel, or new construction) the downspout shall be labeled as an overflow device with minimum 1-1/2 inch letters on a minimum 4 inch x 6 inch plate.
   F. Rainwater systems routed directly to underground drainage systems shall have a cleanout a maximum of 24 inches above finished grade on the outside of the building.
   G. Chambered leach fields are preferred when designing septic systems.
   H. Backwater valves require having removable gates to allow cleanout.

10. Condensate Piping
   A. Condensate piping installed in a conditioned space or below the insulated building envelope shall be insulated with a minimum 1/2 inch insulation.
   B. Condensate traps shall be constructed with a threaded cap on the non-venting side of the trap for use as a cleanout.
   C. All 90-degree elbows in condensate piping shall use a threaded tee with cap for use as a cleanout.
   D. Condensate traps shall not be manufactured of hard 90-degree elbows.
   E. With PCFM prior approval, in retrofit applications where a condensate trap and drain line are installed within the insulated building envelope a RectorSeal EZ-Trap or prior-approved equal may be used in lieu of a copper trap.
   F. Rooftop equipment condensate drains are to be hard piped with unions installed to facilitate maintenance operations. Flex connectors are not to be utilized within condensate drain systems.

11. Natural Gas Systems
   A. Gas piping shall NOT be installed below concrete slabs. Service entrance shall be through an exterior wall above grade.
   B. Gas piping shall be piped overhead and penetrate through the roof at the point of equipment connection.
C. Gas piping shall not be laterally run across rooftops to serve multiple pieces of equipment.

D. Do not install piping in concealed locations unless piping is provided with secondary containment sleeve with the sleeve open on both ends.

E. In new or major renovation projects, medium pressure gas systems shall be prior approved by PCFM no later than the design development phase.

F. PCFM shall have the option to witness all piping system pressure testing.

G. Locate natural gas valves for easy access. Do not locate valves within return air plenums.

H. Install drips at points where condensate may collect.

12. Meters and Gauges

A. Install thermometers and gauges as appropriate to identify system properties. Locate and size gauges to allow the reading of instrumentation from a readily accessible location. Extend reading surfaces beyond face of insulation. Scale shall be appropriate for each individual system.

B. Gauges are to be liquid-filled type.

C. Provide the manufacturer recommended upstream and downstream straight pipe diameters for proper reading of flow meters.

D. Meters shall be adjustable for changes in system operational parameters.

13. Identification for Plumbing Components

A. Provide the appropriate identification for plumbing components including equipment, warning signs/labels, pipe labels, valve tags, and warning tags. Labels and tags are to be specified to be durable and facilitate long term use.

B. Equipment tags are to be affixed to each individual piece of equipment and include unique equipment numbers.

C. Valve tags are to be brass, affixed to each valve, and include a unique identifier.

D. Pipe labels are to be pre-printed, color coded, with letters indicating service, and flow direction in accordance with ASME A13.1. Adhesive or stenciled pipe markers are not acceptable for interior installation. Install all pipe markers at maximum 10-foot intervals and within 5 feet of a floor, ceiling, or wall penetration.

E. Pipe labels are to be sized to allow easy viewing.

Division 22 - Plumbing – Products

14. Plumbing Fixtures and Manufacturers

A. Electric Water Coolers

1) Dual-Height ADA: Elkay Model LZSTL8LC.

2) Dual-Height ADA with Bottle Filler: Elkay Model LZSTLG8WSLK.
3) Single-Height ADA: Elkay Model EZS8LF.
4) Single-Height with Bottle Filler ADA: Elkay Model LZSG8WSLK.
5) Or approved equal of Elkay, Haws, Acorn Engineering Inc.

B. Faucets:
   1) Break Room or Conference Room type: Delta Models 100LF-HDF, 101LF-HDF or 400LF-HDF.
   2) Lavatory: Chicago Model EVR-A12A-41ABCP.
   3) Drinking Water Faucet: Monogram Brass MB111.
   4) Mop Sink Faucet: Chicago Model 540-LD897SWXF204CP or T&S Model B-0665-BSTP.
   5) Or approved equivalent (Break Room or Conference Room type) of Chicago/Gerberit, Delta, Sloan, Symmons, TS Brass, and Zurn.

C. Fixture Carriers: Josam, Jay R. Smith, MIFAB, Wade, Watts, and Zurn.

D. Flush Valves:
   1) Sloan Royal Model WES-111 Dual Flush 1.1-1.6 gpf.

E. Insulation Kits (for ADA P-traps and supplies):
   1) ProFlo Model # PF200.
   2) Or approved equal of McGuire, MIFAB, ProFlo, Truebro, Watts, and Zurn.

F. Lavatories (Vitreous China):
   1) Counter-top: Kohler Pennington, K-2196.
   2) Counter-top ADA: Kohler Pennington, K-2196 or Kohler Aqualyn.
   5) Or approved equal of American Standard, Kohler, and ProFlo.

G. Mop Basins:
   1) Mop Basin: Fiat Model MSB-2424 Series in molded stone, Florestone #MSR-2424 Series in molded stone, Mustee Model 63M. Faucet: Chicago Model 540-LD897SWXF204CP or T&S Model B-0665-BSTP.
   2) Hose and Bracket: Fiat 832-AA.
   3) Or approved equal of Acorn, Elkay, Florestone, Metcaft, Mustee, and Zurn.

H. Sinks, Stainless Steel:
   1) Elkay Model # ELUHAD161655 with “Perfect Drain” assembly.
   2) Elkay Model # ELUHAD311855 with “Perfect Drain” assembly.
3) Or approved equal of Advanced TABCO, Elkay, Just, and ProFlo.
4) All stainless steel sinks shall be a minimum of 18 ga. material.

I. Solids Interceptors (INT):
   1) Approved equal of Jay R. Smith, MIFAB, Watts, Zurn, and Wade.


K. Water Closets (vitreous china):
   1) Floor-mounted Floor Outlet: Kohler Model #96053 WELLCOMME, 1.1-1.6 gpf.
   2) Floor-mounted Floor Outlet ADA: Kohler Model #96057 HIGHCLIFF; Kohler Model K-96057 Highcliff Ultra, 1.1-1.6 gpf.
   3) Floor-mounted Wall Outlet: American Standard Huron.
   4) Wall Hung: Kohler Model #4325-0 Kingston 1.28/1.6 gpf mounted to match existing height or per ADA requirements; American Standard Afwall Millennium FloWise. Provide Bar-Industries SK1000U water closet kick stand or PCFM prior-approved equal.
   5) Floor Mounted, Tank type: American Standard Cadet Pro Right Height Elongated Toilet; Koller Model K-5310 Cimarron Comfort Height.

L. Water Closet Seats:
   1) Kohler Model # Lustra, K-4666.
   2) Or approved equal of Bemis, Church, and Kohler.

M. Water Filter:
   1) Aqua-Pure full flow drinking water system Model # Easy CYST-FF.

N. Individual System Backflow Preventers:
   1) Backflow preventers shall be manufactured of Type L copper.
   2) Approved equal of Watts Series 007 or 009 or FEBCO Series 860.

15. Penal Ware

A. Fixture Types:
   1) Combination Fixtures, Lavatories, Urinals, Water Closets.
   2) Acceptable Manufacturers: Acorn International to match existing PCFM installations.

16. Valves for Plumbing

A. Point of use thermostatic mixing valves: Watts Model LFUSG-B-M2; Caleffi Model 600079A; Lennard Series LF Point of Use.
B. Manual isolation valve bodies shall NOT be brass.
C. Acceptable manufacturers for manual valves are Apollo, Nibco, and Watts.

17. Plumbing Insulation
A. Insulation Types:
   1) Condensate drain piping, domestic hot water, hot water return piping, domestic cold water piping prone to freezing.
   2) Acceptable Manufacturers: Owens-Corning, Johns Manville, and Certain-Teed.

18. Plumbing Specialties
A. Acceptable Manufacturers for Cleanouts, Downspout Nozzles, Roof Drains: Josam, Jay R. Smith, Wade, Watts, and Zurn.
C. Water Hammer Arrestors shall be of either metal bellows type or piston style with a gaseous charged chamber type. Acceptable manufacturers are Wade, Sioux Chief, Watts, MIFAB, and Zurn-Wilkins.
D. Escutcheons shall be chrome finished. Acceptable manufacturers are ProFlo Standard Type, PFE Series.
E. Floor Drains and Floor Sinks:
   1) All new floor drains, area drains, and floor sinks shall have a trap guard installed.
   2) Acceptable Manufacturers are Josam, Jay R. Smith, Wade, Watts, and Zurn-Wilkins.
F. Shower Valves:
   1) Basis of Design, Standard: Symmons S-9601-P, 2.0 GPM, pressure balanced system, user temperature adjustable handle, adjustable handle stop screw, all metal construction, minimum 5-year warranty.
      a. Shower valves shall be provided with scald guard.
      b. Acceptable manufacturers are Delta, Symmons, and Scald Guard.

19. Plumbing Equipment
A. Acceptable manufacturers for water heaters are Bradford White, Rheem/Ruud, and AO Smith.
B. Acceptable manufacturers for recirculation pumps are Bell & Gossett, Paco, and Taco.
C. Acceptable manufacturers for domestic water booster pumps are Goulds, and Armstrong.
D. Acceptable manufacturers for grease traps are Zurn, Josam, and Jensen Precast.
E. Acceptable manufacturers for sump pumps are Liberty.
F. Acceptable manufacturers for sanitary sewerage pumps are Liberty, Zurn, and Goulds.
G. Acceptable manufacturers for septic tanks are Jensen Precast, and Norwesco.
Division 23 – Heating, Ventilation & Air Conditioning

1. General Requirements
   A. Duct, piping, and conduit runs on rooftops shall be allowed at PCFM’s discretion only where necessary to meet a particular code requirement in an application-specific installation.
   B. Piping shall not be directly embedded in concrete or masonry.
   C. All equipment shall have adequate maintenance access as required by mechanical and electrical codes and as recommended by the equipment manufacturer.
   D. For telecommunications room and closet HVAC requirements, refer to Division 27 Communications Section.

2. Central Plant Systems
   A. The Downtown District Loop: The downtown district loop, which is sourced from the Central Plant located at 190 W Congress St., provides chilled water to Admin West (150 W Congress St), Admin East (130 W Congress St), Superior Courts (110 W Congress St), the Historic Courthouse (115 N Church St), 33 N Stone, and the Legal Services Building (32 N Stone).
   Design temperatures for the downtown district cooling loop are:

   
<table>
<thead>
<tr>
<th></th>
<th>Supply</th>
<th>Return</th>
</tr>
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<tbody>
<tr>
<td>Chilled Water:</td>
<td>45 deg F</td>
<td>55 deg F</td>
</tr>
</tbody>
</table>

   1) Where building re-heat systems are comprised of electric strip heaters (preferred reheat type), strip heaters shall be designed to meet calculated loads with minimum air flows not less than manufacturer’s recommendations to protect the heating element.

   2) When cooling loads are provided by the district system chilled water, plate and frame heat exchangers shall be used as an interface. Heat exchangers shall be designed with a 2 deg F approach temperature.

   B. The Downtown Government Complex: The Downtown Government Complex, which includes Admin West (150 W Congress St), Admin East (130 W Congress St), Superior Courts (110 W Congress St), and the Historic Courthouse (115 N Church St), is part of the Downtown District Cooling Loop and receives heating hot water from the main Central Plant located at 190 W Pennington St.

   1) During cooling months (March through September), the central hot water system is not active, VAV systems shall be controlled such that supply air discharge temperature and volume maintain cooling set point in spaces served without over-cooling. The system design shall handle the dehumidification of the space, again without over-cooling.
2) Design temperatures for the Downtown Government Complex heating water loop are:

<table>
<thead>
<tr>
<th>Supply</th>
<th>Return</th>
</tr>
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<tbody>
<tr>
<td>170 deg F</td>
<td>150 deg F</td>
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</tbody>
</table>

C. Single Building Plants: Individual buildings with central plant systems shall be either water-cooled or air-cooled, operated in a lead-lag configuration with redundancy. Minimum design efficiencies for new or replacement chillers shall meet IECC or ASHRAE 90.1 requirements.

3. Unitary Systems

A. Unitary systems consist of single packaged units or unitary split-system (and mini-split systems) of cooling only, cooling with gas-fired heating, or heat pump type systems.

B. Where natural gas exists to a site, gas-fired heating equipment shall be used.

C. Unitary systems shall be a minimum of IECC or ASHRAE 90.1 requirements.

D. Unitary systems shall be provided with an economizer section as part of the base specifications to comply with the currently adopted energy code or ASHRAE 90.1. Where not required by code, a motorized damper may be used in lieu of an economizer and shall follow the same sequence of operations as an economizer.

E. Hail guards are to be provided on all rooftop or ground mounted coil equipment.

F. Mini-Split / Ductless Systems:
   1) All units serving occupied spaces shall provide mechanical ventilation of outside air to the space via the indoor fan section.
   2) Outside air connections to units shall be routed either through the wall at which the unit is mounted (if an exterior) or through the roof. If the distance between an exterior location and the outside air connection is sufficient to require a supplemental outside air fan, the supplemental fan shall be in an accessible space.
   3) Exception: Where outside air is provided to the space by a separate mechanical system outside air shall not be provided by the mini-split or ductless system.

G. Unitary equipment of any size shall be commercial grade equipment. Residential / light commercial units may only be specified or installed with prior approval by PCFM.

H. Rooftop equipment condensate drains are to be hard piped with unions installed to facilitate maintenance operations. Flex connectors are not to be utilized within condensate drain systems.

I. Base unit specifications shall be AHRI listed where a listing category for specified equipment exists and specified or provided equipment is within the capacity range of the AHRI listings.
J. Filtration:
   1) Where units are of sufficient tonnage and have a pre-filter option the pre-filter shall be a MERV 8 and final filter a MERV 15 unless an application specific requirement requires a higher level of filtration efficiency.
   2) Base filtration for packaged rooftop or split systems shall be a MERV 8 filter.

K. Equipment mounted on roof curbs shall be secured to the roof curb.

L. Unit warranty shall include short cycle protection with a minimum 3 minute on and 3 minute off time in cooling and heating cycles. Control cycle per hour settings shall not limit compressor to a number of cycles per hour less than the short cycle protection run time allows (max 10 cycles per hour).

4. Air and Water Cooled Chillers
   A. Only chillers that are ARI certified and have been manufactured for at least three years are acceptable.
   B. Capacity control is preferred through the use of VFDs.
   C. Compressor motors shall be hermetically sealed. Compressor motors shall be guaranteed by the manufacturer for continuous operation at the nameplate rating. A load-limit system provides protection against operation in excess of this rating. The control circuit shall prevent motor energization unless positive oil pressure is established. Impellers are keyed directly to the motor shaft and locked in position. Motor terminal pads shall be supplied with a removable sheet metal terminal box enclosing the terminal board area.
   D. Chiller shall have a microcomputer control panel that is factory installed and tested. All controls necessary for the safe and reliable operation of the chiller shall be provided including oil management (when required), purge operation, and interface to the starter or VFD. Control panel shall be user accessible to display diagnostic data and log of faults, current operating parameters and setpoints. Chiller shall be connected to Pima County’s central EMCS via the BACnet protocol.
      1) Water Cooled Economizer: Economizer shall be provided and constructed in accordance with ASME Section VIII, Division I.
      2) Air Cooled: The condensing coil section shall be provided with hail guards provided by the manufacturer.
   E. Minimum warranty is a 5-year leak warranty from initial start-up.
   F. Acceptable manufacturers include Carrier, Trane, and York.

5. Cooling Towers and Condensers
   A. A rigorous water treatment system shall be required for consideration of any evaporative condenser system. The proposed system shall be reviewed by PCFM during the design phase of each project.
B. Condensing water pumps shall have positive head on the suction side. A check valve shall be provided to prevent the tower basin from flooding when the pump is off. Pumps shall have mechanical seals. Condenser water pump and piping design shall avoid the use of locations requiring a pit.

C. Cooling towers shall be energy efficient design with tower’s performance certified by an independent test laboratory or field certified by an independent test and balance agency provided by the Contractor. Tower capacity should be rated 125% of actual building cooling load and designed for a 78°F WB condition.

D. When plate and frame heat exchanger economizer system are used, design should incorporate a two-degree approach, with minimum surface area specified by the design engineer.

E. Cooling towers shall be of corrosion resistant materials and/or non-metallic construction.

F. Provide make-up and blowdown flow metering.

G. Cooling towers shall be specified with integral sheer connector mounting design, factory pipe connections, and a cleaning system. The system shall be a side stream filtration system or a Pima County-approved equivalent.

H. Cooling towers shall be provided with drift elimination devices.

I. Basin heaters shall be provided in all cooling towers.

J. Vibration sensors with field adjustable acceleration sensitivity setpoint shall be provided with each fan drive.

K. Acceptable cooling tower manufacturers include Baltimore Air Coil, EVAPCO, and Marley.

6. Air Handling Systems/Units

A. Base face velocity across coils is preferred at 400 fpm to lower fan HP, energy use, and sound levels.

B. Air intake louver face velocity is preferred at 500 fpm to reduce water entrainment.

C. Preference is for air handling units to have a fan array system in lieu of a single fan where available for system sizing applications.

D. Filtration is to incorporate MERV 8 prefilter with MERV 15 final filter.

E. Base unit specifications, including supply fans within the scope of AHRI.

F. Blower motors greater than 3/4 HP shall be NEMA Premium type.

G. Unit sound performance data shall be provided using AHRI Standard 260 test methods and reported as sound power.

H. Equipment manufacturer provided VFDs shall be certified to AHRI Standard 1210 "Performance Rating of Variable Frequency Drives" to ensure documented and reliable VFD efficiency.
I. A factory-mounted, weather resistant (enclosed and gasketed to prevent water and dust intrusion), light emitting diode (LED) fixture shall be provided in sections of the unit for maintenance and service visibility. All lights within the unit shall be wired to a single switch within the factory provided service module. The service module shall include a GFCI receptacle separate from the load side of the equipment. Electrical Contractor shall be required to provide a 120V supply to the factory-mounted service module for the marine light circuit and for the GFCI receptacle circuit per NEC.

J. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).

K. Acceptable Air Handling Unit manufacturers include Energy Labs, Carrier, Trane, and York.

7. Variable Air Volume (VAV) Boxes
   A. All VAV boxes shall have DDC controls utilizing the BACnet protocol.
   B. Single point power connection and wiring shall comply with NFPA 70.
   C. Electric heating coils shall be ETL Listed to UL 1995 and provided by the manufacturer. The heating control panel shall be integral with a NEMA 250, Type 1 enclosure. Include a hinged access door to all controls and safety devices. Electric coils shall be provided with a primary automatic reset thermal cutout, a manual reset thermal cutout, and a differential airflow switch for proof of airflow.
   D. Acceptable manufacturers include Titus, Krueger, and Price.

8. Evaporative Coolers and Make-Up Air Units
   A. All make-up air units shall have a gas-fired heating section and an evaporative cooling (direct or indirect) cooling section.
   B. Make-Up Water:
      1) Provide make-up supply water and drain ball valves inside the building.
      2) Provide local make-up water valve at each cooler.
      3) All piping shall pitch to a drain valve.
      4) Provide compression fittings on all pipes outdoors that may freeze.
      5) Provide a hose bib within 50 feet of each cooler.
      6) Cooler base shall allow water to drain.
      7) Water shall be recirculated within the basin a minimum of 12 hours between dump cycles.
   C. Provide space to maintain, remove and replace coolers. A minimum of 4’-0” should be provided on all inlet sides of each cooler.
   D. Blower motors greater than 3/4 HP shall be NEMA Premium type.
E. Evaporative coolers shall utilize a cell deck type exchanger. Media pads are not to be used.

9. Energy Recovery Ventilators (ERVs)
   A. Unitary ERV systems or stand-alone packages used in conjunction with unitary cooling/heating systems are preferred over the bolt-on accessory type.
   B. Where an ERV is used in conjunction with a unitary piece of equipment the preferred ERV type is a stand-alone package with exhaust and supply ducted from the space being served and the unitary equipment serving the space with bypass functionality.
   C. Energy Recovery Ventilators may be plate and frame or enthalpy wheel type per specific application.
   D. Blower motors greater than 3/4 HP shall be NEMA Premium type.
   E. ERV unit controls shall be DDC type and connected to Pima County’s central EMCS system.
   F. Unit shall have VFD for modulation of the blower motors.
   G. Minimum unit efficiency: 78 percent.
   H. Filtration: Minimum MERV 8.
   I. Acceptable manufacturers include Greenheck, Airxchange, and Venmar.

10. Roof Curbs and Roof Caps
    A. Standard equipment roof curbs shall be provided by the equipment manufacturer and provide for sound and vibration isolation including layers of high density sound board and batt insulation.
    B. Specialty vibration isolation curbs shall be provided in application specific instances.
    C. The minimum roof curb height is 12 inches.
    D. Roof caps shall extend such that the opening shall be a minimum of 12 inches above finished roof.
    E. Roof curbs for equipment mounting shall be secured to the roof structure. Curbs shall be permanent in nature without the use of metal stands. All rooftop mounted equipment containing rotating or reciprocating components are to utilize vibration isolation components.

11. Outside Air Requirements
    A. Outside air calculations shall be based on either ASHRAE 62.1 or 62.2 as referenced in the applicable USGBC program per Section 1.B, or the IMC, or IRC as adopted by PC. Where a project is not following the USGBC path, outside air calculations may be based on the version of the IMC currently adopted by the County.
      1) Fractional population counts are not allowed. Fractions should be rounded up to the nearest whole number.
B. Outside air, as a percentage of total supply cfm, shall be indicated in the mechanical equipment schedules along with the mixed air temperature.

1) Where multi-stage unitary systems are specified the outside air, as a percentage of total supply cfm, shall be indicated in the mechanical equipment schedules along with the mixed air temperature for each fan stage.

C. Sequence of Operation:

1) Basis of Design: The fan that supplies the outside air to a space shall run continuously while the space is occupied. While a space is unoccupied the fan that supplies the outside air shall auto-cycle on a call for heating or cooling.

2) Where demand control ventilation is supplied, the supply fan shall operate at a minimum CFM until space CO2 sensor(s) reach maximum setpoint. Upon call from a CO2 sensor the OA damper shall be opened to the max outside air CFM until the CO2 level is below setpoint by 100 ppm.

D. Outside air inlets shall be provided with an automatic damper arranged to keep the damper closed during unoccupied hours and resume automatic control during occupied hours. Outside air inlets shall be designed with security and other hazard considerations.

E. Where outside air intake or relief hoods are used, roof curbs shall meet the requirements of the Roof Curb section.

12. Exhaust Systems

A. The exhaust of Break Rooms shall be determined on a case-by-case basis at the start of design. When incorporated, the Break Room shall be completely exhausted and shall be negative in space pressure to surrounding spaces. Air shall not be returned from a break room to the return air side of an HVAC system.

B. Break room or restroom exhaust fans shall operate continuously in conjunction with the HVAC system to provide exhaust and outside air relief except during night setback and morning warm up/cool down. During this scenario, exhaust fan(s) shall not operate and the outside air intake dampers of all HVAC cooling/heating equipment shall be closed.

C. Rooftop centrifugal exhaust fans are preferred for restrooms and break rooms.

D. All exhaust or ventilation fans shall bear a permanently affixed manufacturer’s engraved metal nameplate containing the model number and individual serial number. All fans shall bear the AMCA Sound and Air Performance seal and shall be UL Listed.

E. Application specific exhaust or relief fans not related to restrooms or break rooms shall be controlled appropriately to exhaust the areas they serve. Sufficient outside air shall be provided to meet the exhaust requirements of restrooms, break rooms, and any application specific exhaust or relief fans.
13. Air Distribution and Air Devices

A. The design professional, with assistance from PCFM, shall determine at the start of a renovation project design as to the relative cleanliness of the existing HVAC air distribution System. If found to require system cleaning, the design professional will determine the appropriate methods to implement a system cleaning.

B. All supply air devices shall have adjustable throw pattern capability.

C. Perimeter zone air distribution systems shall be designed such that the air discharged to a perimeter zone (maximum depth of 15 feet from inside surface of exterior wall) is served from the same HVAC unit that provides cooling and heating to general space air devices in the same zone.

D. No single occupied space shall be supplied cooling or heating air from two different sources.
   1) Exception: Single multipurpose spaces large enough in square foot and tonnage to require multiple HVAC units may have multiple units serving the space. Controls shall be provided as required to prevent simultaneous heating and cooling for consistency in space temperature and thermal comfort.

E. Thermostatically controlled air devices may be used in certain applications subject to approval by PCFM no later than the Design Development phase in all projects.

F. Maximum Air Device Noise Criteria (NC) rating shall be per the recommendations of ASHRAE based on space type.

G. All ceiling supply air devices in office type applications shall include an opposed blade damper that is adjustable through the face of the air device or a manual balancing damper located in close proximity to the air device.

H. Where there is insufficient height to install a properly supported 90-degree flexible duct elbow into the top of an air device a box plenum with a side connection shall be used.

I. Acceptable manufacturers of air control boxes include Kruger, Price, and Titus.

14. Ductwork, Dampers, and Duct Lining

A. Ductwork shall be designed, fabricated, supported, and installed per SMACNA Standards.

B. No flexible duct connections over hard ceiling or inaccessible ceiling areas. The use of duct socks require approval prior to the development of DD Design.

C. Flexible duct shall be limited to 5’ in length.

D. Insulated, Flexible Duct shall be UL 181, Class 1, woven and coated fiberglass film supported by helically wound, spring-steel wire; fibrous-glass insulation; fiberglass reinforced metalized film laminate vapor barrier. Pressure rating shall be 10-in wg positive and 2-in wg negative. Acceptable manufacturers include Thermaflex, NovaFlex, and FlexMasterUSA.
E. Where access is required for dampers in hard duct above hard ceilings a minimum 24-inch x 24-inch access panel shall be installed. Smaller accesses (18-inch x 18-inch) will be permitted for inspection or valve operation within an arm’s length distance from the bottom of the ceiling.

F. All transfer air installations require lined boots to limit noise transfer.

G. Where dampers are installed in ductwork, a streamer (high visibility orange) that extends a minimum 6 inches below the duct shall be installed. Where ductwork is installed tight to ceilings dampers shall be aligned above a removable ceiling tile.

H. All dampers shall be at an accessible (preferably ladder) height. Where dampers are installed such that a lift is required to access, PCFM approval is required no later than the Design Development submittal stage. Dampers shall not be installed greater than 30 inches above a ceiling unless approved by PCFM.

I. Equipment requiring service or maintenance shall not be located above a hard lid without adequate access.

J. Fire/Smoke Dampers (Motorized) shall be labeled according to UL 555S by an NRTL. Preference is for out-of-wall fire damper (Type “B2”) style with integral smoke Detector factory wired for single-point connection. Leakage and rating shall be as required per application.

K. Fire Dampers (non-Motorized) shall be labeled according to UL 555S by a Nationally Recognized Testing Laboratory (NRTL). Preference is for out-of-wall fire damper (Type “B2”) style. Acceptable manufacturers include Greenheck, Ruskin, and Pottorf. Other manufacturers require prior approval by PCFM during project design phase.

L. Duct and equipment internal surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

M. Fibrous-Glass Duct Liner shall Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." Apply Antimicrobial Erosion-Resistant Coating to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

N. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL and shall meet the sealant requirements of the International Mechanical Code (IMC) as adopted by Pima County.
15. Mechanical Piping, Refrigerant Piping, and Piping Insulation

A. Support piping with hangers, trapeze, framing supports, or stands at maximum spacing as outlined within the International Mechanical Code. Utilize insulation inserts as appropriate to prevent the crushing of insulation or compromise of vapor barrier for cold conveyance applications.

B. Where access is required for valves above ceilings a minimum 18-inch x 18-inch access panel shall be installed. Valve handle shall face the access panel for ease of access.

C. Valves shall not be installed greater than 2 feet above a ceiling or 11 feet above the finished floor.

D. Where valves are installed above ceilings a streamer (high visibility orange) that extends a minimum 6 inches below the piping shall be installed. Position all valves above an accessible opening (removable ceiling tile or access panel).

E. Where any split-system units are used, refrigerant pipe routing shall be shown on the construction documents demonstrating preferred routing of piping and any reduction in system capacity based on refrigerant line length.

F. Install piping at right angles or parallel to building walls to the greatest extent as possible. Piping shall be installed to permit the servicing of valves and components and install free of sags and bends.

G. Extend vertical piping sleeves for penetrations 1” above floor for wet areas.

H. Low point drains shall be installed at all low points in the hydronic piping system mains and elsewhere as required for system drainage.

I. High point air vents shall be installed at all high point locations which have the potential to trap air.

J. In piping sections prone to freezing, provide electric heating cable. Installation shall be in accordance with NFPA 70. Install cable across expansion, construction, and control joints in accordance with manufacturer’s written instructions. Provide the necessary slack to allow movement without damage to cable. Install insulation and warning tape on piping where equipped with electric heating cables.

K. Install pipe escutcheons for piping penetrating walls, ceilings, and finished floors. ID to closely fit around pipe, tube, and insulation of piping with OD that completely covers opening.

L. Roof mounted piping shall utilize C-Port or Mifab Rubber supports.

M. All mechanical insulation installed indoors shall maintain a flame spread index of 25 or less and a smoke developed index of 50 or less as determined by testing in accordance with ASTM E84.

N. Hard sections of insulation are to be used at piping and equipment support locations to prevent the crushing of jacketing and insulation. A continuous vapor barrier shall be maintained on all services operating at below ambient conditions to prevent the formation of condensation.
O. PCFM shall have the option to witness all piping system flushing, cleaning, and pressure testing.

P. Expansion Tanks shall be welded steel of the removable bladder type. Each expansion tank shall be provided with appropriate means of disconnect and serviceability to conduct maintenance and remove and replace the bladder when required.

Q. The use of Viega Press Fittings is permitted for chilled water and domestic water applications.

R. Welded Piping:
   1) All welding shall be done by certified welders, with certifications on file with Pima County on a per project basis. Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
   2) Pipe and Pressure Vessel Welding qualifications shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IX.
   3) Field inspections by PCFM representatives are required for all welding in addition to any required “special inspections”.
   4) Offsite inspections by PCFM representatives are required when welding is performed at a Contractor’s facility prior to welded materials being transported to PC property.

16. Meters and Gauges
   A. Install thermometers and gauges as appropriate to identify system properties. Locate and size gauges to allow the reading of instrumentation from a readily accessible location. Extend reading surfaces beyond face of insulation. Scale shall be appropriate for each individual system.
   B. Gauges are to be liquid filled type.
   C. Provide the manufacturer recommended upstream and downstream straight pipe/duct diameters for proper reading of flow meters.
   D. Airflow and waterflow measurement stations shall be adjustable for changes in system operational parameters.

17. Identification for HVAC Components
   A. Provide the appropriate identification for HVAC components including equipment, warning signs/labels, pipe/duct labels, valve tags, and warning tags. Labels and tags are to be specified to be durable and facilitate long term use.
   B. Equipment tags are to be affixed to each individual piece of equipment and include unique equipment numbers.
   C. Valve tags are to be brass, affixed to each valve, and include a unique identifier.
   D. Pipe labels are to be preprinted, color coded, with letters indicating service, and flow direction in accordance with ASME A13.1. Adhesive or stenciled pipe markers are not acceptable for interior installation. Install all pipe markers at maximum 10 foot intervals and within 5 feet of a floor, ceiling, or wall penetration.
E. Duct labels are to include the identification of duct service, duct size, and flow direction.

F. Pipe and duct labels are to be sized to allow easy viewing.

18. Testing, Adjusting, and Balancing (TAB)

A. General Requirements

1) A Contractor certified by the Associated Air Balance Council (AABC) or the National Environmental Balance Bureau (NEBB) shall be used for the Testing, Adjusting, and Balancing (TAB) process. And the testing and balancing of mechanical systems shall be in accordance with AABC or NEBB standards and guidelines.

B. Submittal Requirements

1) Design and Shop Drawing Review Report:

   a. The TAB Contractor shall review the design and/or the shop drawings for review and sign off that all necessary balancing devices, measurement stations, and straight length distances are adequate and accessible to provide reliable TAB measurements and results.

   b. The TAB Contractor shall provide submit a report with a marked-up copy of the drawings annotated to confirm the location of the designated flow control and balancing devices and the preferred testing and measurement locations. The drawing markups shall also identify any missing or additional balancing devices that are necessary or recommended for balancing each system. Each drawing markup shall contain a summary list of the missing or additional devices for review by the Mechanical Contractor and Engineer for potential inclusion in the system installation.

2) TAB Plan and Qualifications:

   a. The TAB Contractor shall submit a TAB Plan and Qualifications to the Pima County, the Engineer of Record and the Commissioning Agent (CxA) for review, at least 4 weeks in advance of conducting any required TAB work. Electronic files are acceptable. The TAB Plan and Qualifications shall include the following:

      I. An outline of the TAB procedures and approach for each system type. The TAB procedures and approach shall satisfy the contract documents and TAB specifications. If the TAB procedures and approach are not defined in the contract documents or TAB specifications, then the TAB procedures and approach shall meet the requirements of NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems Section 7.3 (Preliminary TAB Procedures) and/or AABC National Standards Section 20.4 (Procedures).
II. A project specific list of the energy management control system (EMCS) control sequence of operation setpoints that will be determined by TAB, and the associated specific procedures to determine the EMCS setpoints. The TAB Contractor shall coordinate with the EMCS Contractor to obtain and review the sequence of operation.

III. The associated TAB forms and the drawings to be used in the TAB work. The TAB drawings shall include the locations of all the designated flow control and balancing devices and all testing and measurement locations. And the TAB forms shall be pre-filled with all available project design parameters.

IV. TAB Contractor qualification certificates.

V. TAB instrument calibration certificates. All TAB instruments shall be calibrated at least every six month or more frequently if require by the instrument manufacturer.

C. TAB Execution

1) Airflow sensor calibrations:

a. All EMCS terminal unit airflow sensors shall be calibrated by the TAB Contractor and the calibration factors shall be provided to the EMCS Contractor for input into the EMCS. The TAB Contractor shall coordinate and confirm with the ECMS Contractor that all calibration factors are per the TAB results. The calibration factors shall also be documented in the TAB Report.

b. All EMCS air-handling unit and fan coil unit outside airflow measuring stations and sensors shall be independently measured and verified by the TAB Contractor. If the airflow stations and sensors allows for calibration either locally with the airflow station or within the EMCS, the TAB Contractor shall calibrate the airflow measuring stations and sensors in coordination with the EMCS Contractor. The final calibration factors and the results of the TAB Contractor’s independent outside airflow measurements compared to the EMCS airflow station and sensor readings shall also be documented in the TAB Report.
2) Water flow meter verifications.
   a. All hydronic system water flow meters shall be independently measured and verified by the TAB Contractor, with the results documented in the TAB Report. An acceptable method of verification is to measure the system flow rate using the pump manufacturer’s pump curve based on the measuring pump head (discharge minus suction pressure) with the pump operating at the design RPM per the pump curve. If the system has all pressure independent control valves, another acceptable method is to command all system valves fully open via the EMCS and compare the flow meter reading with the sum of the maximum flow rates for all the pressure independent control valves.

3) The TAB Contractor shall maintain a list of issues and deficiencies for the General Contractor and Mechanical for review by Pima County, Engineer and CxA on demand. The TAB Contractor shall immediately report any issues and deficiencies discovered which may affect or delay the TAB process.

4) The TAB Contractor shall provide access for the Pima County, the Engineer and the CxA to witness TAB work.

D. Reporting and Commissioning

1) The TAB Contractor shall submit a Preliminary TAB Report with the completed field forms and data to the Pima County, the Engineer and the CxA for review, within 72 hours following completion of the TAB, and prior to any TAB Field Review & Back-check (see below). The TAB Contractor shall respond to and address all comments provided by the Engineer and CxA.

2) The TAB Report shall include all final EMCS airflow sensor calibration factors, all water flow meter verification results, all final EMCS setpoints (such as maximum duct static pressure setpoint, minimum outside air control damper positions, etc.) and shall include all final balance valve and pressure independent control valve settings.

3) The TAB Contractor shall conduct a TAB Field Review & Back-check, in which the TAB Contractor demonstrates specified results to the Pima County, the CxA and/or the Engineer, after completion of the Preliminary TAB Report.

4) The TAB Field Review & Back-check shall include field demonstrations and back-check measurements of the air-side and water-side systems (including any final EMCS setpoints) performed by the TAB Trade Contractor and witnessed by the Pima County, the CxA and/or the Engineer, for an approximate 10% to 30% sample to be selected by the Pima County, the CxA and/or the Engineer but limited to no more than two days onsite.
5) If the TAB back-checks yield results that are outside the TAB tolerances for more than 10% of the sample, the TAB shall be considered incomplete.

6) The TAB Field Review & Back-check measurements shall be recorded on the Final TAB Report or a separate form or appendix attached to the Final TAB Report, for documentation purposes.

7) Submit the certified Final TAB Report to the Engineer and CxA for review.

19. HVAC Control System

A. All control systems and their component equipment shall be provided with networked controls using the ASHRAE Standard 135 compliant, BACnet IP protocol and connected to the EMCS head-end located in Pima County’s Downtown Central Plant. Deviation from this requirement can only occur with approval from PCFM.

B. All EMCS related wiring shall be green with a white stripe to easily distinguish it from cabling for other systems. All wiring located above ceilings within air pathways shall be plenum rated.

C. DDC system should be designed to allow expandability of at least 1.25 times the total I/O points required.

D. Mini-split type systems serving IT, electric rooms, or similarly regularly unoccupied spaces and lacking support for networked controls may be provided with stand-alone thermostats located in the spaces they are serving with a space temperature sensor connected to the EMCS head-end located in Pima County’s Main Central Plant.

E. Control points for equipment types listed in the sections below shall be mapped to the front end of the EMCS head-end located in Pima County’s Main Central Plant and shall be included in both text and graphical displays.

F. Belimo control actuators with Nibco valves are preferred for AHU system components. Strainers shall be provided upstream of each control valve.

G. Control hardware shall be BACnet Technology Laboratory (BTL) listed and provided by the manufacturer providing the EMCS product(s).

1) Controls implementation and detailing to be coordinated and approved by PC on a project by project basis.

2) Where application specific controllers are provided at specialized equipment, such controllers may be provided by the equipment manufacturer in lieu of the controls Contractor with prior approval by PCFM.

3) Specialty equipment where other protocols such as ModBus or LonWorks are the base protocols supplied by a manufacturer, the use a protocol translation to BACnet device is acceptable and shall be identified in construction documentation and pre-approved by PCFM not later than the DD submittal stage.
H. Acceptable control systems include Delta Controls (preferred to match the majority of existing installations) or Alerton to match existing PC systems.

I. For work in existing buildings, the design professional shall evaluate existing equipment during the design phase of the project.
Division 26 - Electrical

1. Supplemental Requirements
   A. In new construction or major renovation projects, the engineer will design conduit, spare circuit breakers, and electrical capacity for future electric vehicle and solar photovoltaic systems, with system(s) and routing determined on a per project basis. Design at least one 1-1/4” conduit to a possible charging station location.
   B. Design for future solar photovoltaic systems shall include at least one 4-inch conduit and one 1-inch communications conduit. Determine the number of conduits based on anticipated system size. Configure the solar photovoltaic system interconnection point so that the system may be operated without de-energizing the facility.
   C. Do not design ceilings in electrical rooms.
   D. Electrical rooms may be either mechanically cooled or tempered via transfer air. Where an electrical room is tempered by transfer air, design a method of relief or exhaust.
   E. Design dedicated branch circuits for copiers and vending machines.

2. Low-Voltage Electrical Power Conductors and Cables
   A. Design all conductors in conduit, with no more than 3 circuits per home run. Specify that all home run conductors shall be #10 to the first splice point and locate the first splice point in an accessible location in the area of the loads served.
   B. Specify copper conductor only, with minimum size No. 12 AWG, solid for No. 12 AWG and smaller and stranded for No. 10 AWG and larger. Specify that minimum wire size for circuits over 100 feet is No. 10 AWG.
   C. For vibrating and rotating equipment, specify stranded for all wire sizes.
   D. Exposed conductors: specify THHN-THWN, single conductors in conduit.
   E. Conductors indoors: specify THHN-THWN, single conductors in conduit.
   F. Conductors outdoors, underground, or in wet locations: specify XHHW-2, single conductors in conduit.
   G. Outdoors not exposed to direct sunlight: use 125 deg F (70 deg C) temperature for deration calculations.
   H. Outdoors exposed to direct sunlight: use 155 deg F (86 deg C) temperature for deration calculations.
I. Where conductors are subject to extreme heat (155 deg F (86 deg C) temperature change): specify XHHW-2, single conductors in conduit.

J. For systems furniture, use a single No. 10 neutral conductor and wiring circuits such that:
   1) 1 circuit – use all receptacles marked A only. (1 ungrounded and 1 grounded conductor)
   2) 2 circuits- use receptacles marked A and B only (2 ungrounded and 1 grounded conductor)
   3) 3 circuits – use receptacles marked A, B, and C only (3 ungrounded and 1 grounded conductor)
   4) Do not use receptacles marked D.

K. Prohibit the use of metal clad (MC) cable.

L. After Substantial Completion, but not before 6 months of occupancy, specify an infrared scan of splices in conductors No. 3 AWG and larger, and require correction of deficiencies. Specify a follow-up infrared scan of each splice 11 months after date of Substantial Completion. Specify a report that identifies splices checked, scanning results, deficiencies detected, remedial action taken, and observations after remedial action.

M. Specify that underground splices shall be multi-port type listed for submersible use, Polaris Blue or approved equivalent.

3. Grounding and Bonding for Electrical Systems
   A. Specify that all power and lighting conduits shall contain a green wire equipment grounding conductor sized per NEC.

4. Conduits for Electrical Systems
   A. Design of conduit on rooftops shall be minimal, only where necessary to meet a particular code requirement, and approved by PCFM by the Design Development phase.
   B. Specify minimum 3/4” conduit size in all applications.
   C. Design wiring of different system voltages in separate raceways.
   D. Call for three spare 3/4” conduits from each recessed panelboard to the closest accessible space, with insulated bushings on the ends.
   E. Prohibit the use of nonmetallic conduit where ambient temperature exceeds 120 deg F.
   F. Allow no more than 270 degrees of bends and require support within 12 inches of changes in direction.
   G. Design conceal conduit to be routed parallel/perpendicular to building lines and concealed within finished walls (no horizontal runs), ceilings, and floors, unless otherwise allowed.
H. Specify conduit support within 12 inches of enclosures or boxes to which attached.
I. Specify insulated-throat EMT fittings.

5. Underground Ducts and Raceways for Electrical Systems
   A. Inasmuch as possible, lay out underground feeder and branch circuit conduits in non-paved areas.
   B. Specify that all empty conduits be provided with tracer wire and pull string.
   C. Where conductors are installed in conduit such that termination of one end is within an enclosed box or panel not belonging to Pima County, specify that a tracer wire shall be installed on the conduit.
   D. Specify polymer concrete underground boxes only, with molded cover legend “ELECTRIC” and a lockable inner cover (as manufactured by McCain Electric).
   E. Call for underground boxes to be supported on a bed of 1/2 inch to No. 4 sieve crushed stone or gravel, compacted to same density as adjacent undisturbed earth. In paved areas, call for the cover surface to be flush with finished grade. In other areas, call for the cover surface to be 1 inch above finished grade.
   F. For manholes, specify field-cut conduit openings and sealing around penetrations. Specify removable manhole hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of conductors. Specify arms to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances.
   G. Specify conduit in slabs to be run parallel or at right angles to main reinforcement with 1” minimum concrete cover in all directions. Where at right angles to reinforcement, place conduit close to slab support. Secure conduit reinforcement at maximum 10-foot interval. Specify conduits to cross expansion joints at right angles with expansion fittings.
   H. Forbid threadless fittings in concrete unless specifically approved by PCFM or the project Engineer of Record for each specific location.
   I. Specify transition from GRC to EMT before rising above floor.
   J. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, call for extending steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base, and require insulated grounding bushings on equipment terminations.

6. Identification for Electrical Systems
   A. Specify labeling for access doors and panels for concealed electrical items, battery racks, emergency system boxes and enclosures, enclosures and electrical cabinets, contactors, enclosed switches, and circuit breakers, disconnects, enclosed controllers, monitoring and control equipment, all electrical distribution equipment, pushbutton stations, transfer switches, generators, receptacles, lighting control equipment, UPS equipment, variable-speed controllers, and lighting inverters. Transformer labels will indicate equipment served by the secondary and receptacle labels will show panelboard and circuit number on the wall plate. Specify wire markers or tags inside outlet boxes.
B. Require spare conductor identification at each end as spare and location of other end.

C. Require painting conduits containing conductors 1000V and above with yellow paint, with labels at intervals not more than 20’ apart, and on all pullboxes.

D. Require painting conduits containing non-standard voltages a distinctive color, such as for 240V three-phase delta systems. Pima County will determine paint color.

E. In other than dedicated electrical rooms and hallways, specify red warning tape on floor to indicate the boundaries of the NEC clear area. In dedicated electrical rooms and hallways, specify labels reading "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42 INCHES (915 MM)."

F. Specify underground warning tape reading "ELECTRIC."

G. For adhesive products, specify cleaning substrates of substances that could impair bond.

H. For conductors 600V or less in electrical equipment, vaults, pull and junction boxes, manholes, and handholes, specify color-coding conductor tape to identify the phase. Colors are Phase A: Black, Phase B: Red, Phase C: Blue for 208/120V circuits, and Phase A: Brown, Phase B: Orange, Phase C: Yellow for 480/277V circuits.

I. Specify that field-applied color-coding tape for No. 6 and larger is to be half-lap wrapped minimum of 6 inches from terminal points and in boxes with splices. Apply last two turns of tape with no tension and locate to not obscure cable markings.

J. Specify flexible ID tape labels as black on clear (red on clear for emergency power), 1/2 inch for receptacles and switches and 1 inch for all other equipment.

K. Specify laminated acrylic or melamine signs with engraved black letters on clear face, 1/16” thick for signs up to 20 sq. inches and 1/8” thick for signs larger than 20 sq. inches. Frame with mitered acrylic molding and arrange for attachment at applicable equipment, fastened with self-tapping stainless-steel screws or machine screws with nuts and flat and lock washers.

7. Short-Circuit, Coordination, and Arc Flash Hazard Analysis Studies

A. Specify or perform these studies as necessary per project needs and call for all electrical equipment to have with arc flash labels with specific incident energy and PPE levels.

8. Electrical Power Monitoring

A. In new construction or major renovation projects, design separate sub-meters for interior lighting, exterior lighting, and HVAC equipment. If required, design sub-metering for lighting, HVAC, and plug loads per USGBC LEED requirements. Locate sub-meters in the electrical room and connect to the downtown Central Plant EMCS with gateways, connectivity, and software.
9. Lighting Controls
   A. Specify dual-sensor occupancy/vacancy devices, designed for not less than 90 percent coverage without exceeding manufacturer’s coverage limits. Specify that all sensors are to be of the same manufacturer, and all sensors are to be field-adjusted for performance. Remodel projects shall use the same sensors in use in the project area.
   B. When requested by PC FM and within 12 months of date of Substantial Completion, specify on-site assistance in adjusting sensors to suit actual occupied conditions, with up to two visits for this purpose.
   C. Specify programmable 7-day astronomic electronic time switches.
   D. Networked Lighting Controls:
      1) Acceptable manufacturer is Acuity Brands, Inc. nLight. Specify mechanically latched-relays, and that multiple panels interconnect to appear to the operator as a single system.
      2) Specify compatibility and connection with the downtown Central Plant EMCS, with gateways, connectivity, and software as required. Control and monitoring features displayed at the lighting control panel(s) shall be available through the EMCS.
      3) See the Commissioning guideline for further information.

10. Low-Voltage Distribution Equipment
    A. Manufacturers include Eaton, ABB/General Electric, Siemens, and Square D/Schneider Electric.
    B. Specify copper transformer windings and panelboard and switchboard bussing. For panels of all voltages, specify door-in-door panel covers and bolt-on circuit breakers.

11. Multi-Outlet Assemblies
    A. Specify field-installed and field-wired assemblies, not prewired assemblies.

12. Wiring Devices
    A. When conductors larger than No. 12 AWG are installed on branch circuits, call for No. 12 AWG spliced pigtailed for device connections.
    B. Specify straight blade receptacles to be Leviton 5362 or equivalent, back wired with side clamps. Specify Leviton G5362 or equivalent for GFCI devices. Devices used for emergency power shall be red. Specify tamper resistant receptacles in public areas.
    C. Specify 0.035-inch thick, satin-finished stainless steel wall plates with matching screw color for finished spaces. Specify that wall plates in remodeled areas shall match existing in the surrounding area.
    D. Specify metallic, in-use, lockable type covers for wet locations.
13. Fuses
   A. Specify spare fuses in quantity equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

14. Variable-Frequency Motor Controllers
   A. Specify input fused disconnect or circuit breaker, and 3%-line reactors.

15. Lightning Protection for Structures
   A. The engineer will perform a NFPA 780 simplified risk analysis and submit to PC FM for review.

16. Surge Protective Devices
   A. Specify surge protection at all service entrance equipment, and at the next level downstream for panels that serve sensitive electronic loads.

17. LED Interior Lighting
   A. All lighting is to be LED.
   B. Specify minimum can light diameter of 6”, with a minimum 18 inch pigtail such that the driver may be pulled through the fixture opening.
   C. Specify spare light fixtures, 5% of installed quantity for each type on drawings, minimum one.
   D. Where existing fluorescent lamps are replaced with LED lamps, the engineer will determine compatibility between proposed LED lamps and existing ballasts and switching. The Pima County basis of design is Phillips Instafit. Use the Phillips compatibility checker. All other materials shall be submitted for review. Specify that ballasts are to be replaced with instant start type if necessary.

18. Emergency and Exit Lighting
   A. Power emergency and exit lighting from central inverter(s), not integral-battery fixtures. Put this lighting on dedicated circuit(s) with a keyed, labeled maintenance switch(es) in a secure location, typically the electrical room.

19. LED Exterior Lighting
   A. All lighting is to LED with minimum 80 CRI and 3500K CCT.
   B. Specify that proposed exterior fixture locations be marked on the building wall prior to rough-in and mounting, and that PCFM approval is to be obtained for each location.
   C. In major renovation or renewable interior projects, if the percent of exterior lighting changes are minimal, a variance may be requested from PC Development Services to maintain the existing lighting control system.
D. Fixtures at an entry or service point in a facility that is open or accessible outside of the posted operating hours must be served from a separate circuit such that the fixtures remain on when other building-mounted fixtures are off. This lighting arrangement requires a variance from PC Development Services. For projects in other jurisdictions where the County does not have an IGA, prior approval shall be obtained from the Authority Having Jurisdiction no later than the 90% Construction Documents submittal.
Division 27 - Communications

1. Supplemental Requirements

A. The purpose of the PCFM design and construction standards is to describe and specify the minimum building infrastructure required to support the voice, data, and other special systems in Pima County facilities. Designers must incorporate the information provided into their complete set of plans and specifications. This document does not replace any national or local standards, regulations, or codes, but enhances them. If the standards and practices of PCFM exceed national or local standards, regulations, or codes, PCFM practices shall take precedence.

B. This document specifies design and installation of Telecommunication Rooms (TRs), cabling distribution systems, work area outlet locations, cable specifications, testing, documentation, and administration. This document is intended to serve as a guideline and therefore is subject to change on a project-by-project basis. It is the responsibility of the designer to identify inconsistencies in the specific project drawings and request clarification from PCFM.

C. The following table is the baseline quality products to be specified for County buildings.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corning (Primary Choice)</td>
<td>Fiber and Peripherals</td>
</tr>
<tr>
<td>Commscope</td>
<td>Fiber and Peripherals</td>
</tr>
<tr>
<td>Berk-Tek/Leviton</td>
<td>Copper, Fiber, and Coax Products</td>
</tr>
<tr>
<td>Berk-Tek</td>
<td>OSP Copper (ANMW) &amp; (ARMM)</td>
</tr>
<tr>
<td>Chatsworth/CPI</td>
<td>Racks, Cabinets, Grounding Busbars, Ladder and Wire Tray</td>
</tr>
<tr>
<td>Oberon</td>
<td>WAP Enclosures</td>
</tr>
<tr>
<td>Hubbell System One</td>
<td>Floor Boxes, Poke Thru’s &amp; Raceway Systems</td>
</tr>
<tr>
<td>Circa</td>
<td>Copper Cable Protectors</td>
</tr>
<tr>
<td>Pyramid Industries, Panduit, Hydromaxx</td>
<td>Innerduct</td>
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<tr>
<td>ITW LINX</td>
<td>Lightning Protection</td>
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</tr>
<tr>
<td>Fluke Network</td>
<td>Test Equipment for Fiber &amp; Copper</td>
</tr>
<tr>
<td>STI EZ Path</td>
<td>Pathway Sleeves</td>
</tr>
</tbody>
</table>

D. Specify that the installing Contractor is to be certified in the State of Arizona and by the manufacturer to install and extend to Pima County all performance and product warranties offered by the individual manufacturer.

E. Specify that the Contractor must have a BICSI-accredited RCDD on staff who will oversee the installation, as well as the following items:

1) Corning, Commscope and Berk-Tek/Leviton Certified Project Supervisor/Manager and Technicians on staff.

2) 50% of onsite technical staff must be certified as Corning, Commscope, BICSI & Berk-Tek LANmark Installers.

3) Proof of Corning and/or Commscope, and of BICSI and Berk-Tek LANmark certifications must be made available upon request.

2. Telecommunications Room/Building Entrance Facilities

A. Specify Chatsworth Products (CPI) for the equipment used in the TR/EFs.

B. Design EF and TR locations as follows:

1) The PCFM Project Manager must approve all room dimensions and locations. Locate for access from common-use corridors, so that the room may be expanded if necessary, and to minimize horizontal cable distance (maximum 250’ from TR to TO.) Design TRs to be 2-hr rated with a minimum inside dimension of 8ft x 10ft, and height of 10ft clear (dependent on specific requirements) and covered with ¾ in. fire retardant plywood to minimum 8'6” AFF. Additional square footage may be needed, determined on a case-by-case basis.

2) In multiple floor applications, EF and TRs to have all 4 walls vertically stacked.

3) Not part of a server room, mechanical or electrical room, washroom, storage area, or a janitor closet.

4) Away from sources of electromagnetic interference such as electrical transformers, motors, generators, x-ray equipment, elevator equipment, and induction devices.

5) Design 42” wide x 80” high outward-swing (Code permitting) TR doors without doorsills, and with locks, and access control system if available.
3. Environmental
   A. A stand-alone or dedicated HVAC unit should be considered for all TRs, located outside the TR unless approved by PCFM Project Manager.
   B. Design professional must calculate the heat loads for EFs and TRs on a room by room basis due to the nature of the equipment housed in these spaces.
   C. Design professional must coordinate with other disciples to ensure mechanical fixtures (e.g., piping, ductwork, pneumatic tubing, electrical conduits) not related to the support of TR/EF do not pass through, under or enter the TR/EF. In addition, the area adjacent to the exterior of the TR/EF walls shall remain clear for cable pathways entering the TR/EF.

4. Electrical
   A. Light TR/EFs to 50 footcandles 36” above the floor, with fixtures parallel to the racks and not supported by the racks.
   B. Design TR/EFs with a minimum of (2) 120V, 20A (L5-20R) receptacles on dedicated circuits, suspended above equipment racks. Design each rack with a 6-outlet L5-20R PDU at top of the rack.
   C. Design the TR/EFs with quad convenience outlets, one on each wall.
   D. Where required, design and specify UPS units in each TR/EF. Coordinate requirements and backup time with PCFM.
   E. Design a telecommunication bonding system, including main grounding busbar in the ER and a grounding busbar in each TR and server room. Specify bonding racks, access floors, and cabinets using double-hole compression lugs.

5. Cable Pathways
   A. Design conduits and sleeves to extend 4-6” into the TR. If the conduits or sleeves are subject to water intrusion, they must drain away from the room and be watertight. Specify that all conduits and sleeves must have the ends plugged upon installation and that basket tray should not be run through walls.
   B. Design conduits and sleeves to have bushings installed at all ends and at all pull boxes. Design conduit in hard lid or inaccessible ceiling spaces.
   C. Design the conduit system to have no more than 180 degrees of cumulative bends between pull points.
   D. Design a ladder rack system (18” in the ER/MDF and 12” in each TR) around the inside perimeter of and over the top of any free-standing racks, with ladder bottom 7’6” from floor. No other equipment, lights, conduits, fixtures etc. are to be attached to the ladder except as specifically approved by PCFM.

6. Horizontal Pathways
   A. Design a minimum of four (4) 4” sleeves in each TR for horizontal cabling, 8ft above floor. Design a vertical ladder rack for sleeves that are installed above 9’-0” AFF from the bottom of the sleeve to the top of the cable tray for lashing of cables in the vertical run. Basis of design for Sleeves is STI EZ-Path Series 44.
B. In a multi-story building where TRs are stacked, design a minimum of (4) 4” sleeves between the stacked TRs. Confirm the quantity to be used with PCFM Project Manager.

C. The horizontal backbone pathway between the EF/MDF of each building and the nearest designated maintenance vault servicing that facility is to be designed as a minimum of (4) 4” conduits.

D. If the TRs are not vertically stacked on the EF/MDF, design a backbone pathway of minimum (6) 4” conduits between the EF/MDF of the building and each TR. All conduits and inner ducts shall contain a mule tape with footage makers. In multi-story building where TRs are stacked to form a riser, a minimum of four (4) 4” conduits shall be installed between the EF/MDF and the first TR in the stack.

7. Interior Communications Pathways
   A. Design a continuous basket cable tray system on each floor as required, minimum size of 6" x 2" with trapeze style supports. Specify a solid bottom liner in open areas 8’ or below. Basis of design is Chatsworth Products (CPI). Allow not less than 1'-0” clearance measured from the top the tray. Access from the sides will be 6" to 1’. Access to the cable tray from below will be unobstructed its entire length. The tray will stop at all walls, where 2” minimum fire-rated sleeves or conduits will be installed. Specify that tray supported are to be detailed in submittals.

   B. Pathways on floors with fewer TOs than (50) may use “J” hooks when allowed by PCFM.

   C. Design pullboxes at maximum 100’ intervals, with no more than 180 degrees of cumulative bends. Do not design above 40% conduit fill and specify insulated bushings.

   D. Design 1” conduit stubbed above ceiling from each TO. Each 1” conduit will service only one wall outlet, terminated in a 4” x 4” x 2.75” metal box with pull string and a single our double gang mud ring when applicable.

   E. For areas being renovated, the minimum requirement is for horizontal wiring to be properly supported and secured in the work area in either surface raceway, communication power pole raceway, enclosed within the wall or furniture. Specify that the cable will be supported from cable tray to outlet location by CAT 6 approved cable hangers mounted a minimum of 6 inches above the ceiling at a maximum distance of 5’ between hangers.

8. Exterior Communications Pathways
   A. PCFM must approve all designs.

   B. Design a distribution system for cabling that will be served by the building. Pathways may include vaults, handholes, innerduct, conduit, and multi-cell conduit. A detailed telecommunication drawing and pathway logical drawing will be required.
C. Specify the exterior conduit system to meet the following criteria:

1) All conduits will be a minimum of 4 inches with 3 - 1 ¼ Inches ribbed, orange, PVC innerduct installed per conduit., filled not more than 40% capacity, with the ends plugged upon installation, mandreled, and reamed, and provided with footage-marker mule tape. Call for not less than 36” burial depth to top of conduit.

2) Conduit lengths will contain no continuous sections longer than 300 feet. Design pull points for lengths longer than 300 feet.

3) Conduit will have no more than 180 degrees of bends between pull points or more than 90 degrees of bends at any one point. Specify that all bends must have radius not less than six times the internal diameter of conduits 50 mm (2 in) or smaller, or ten times the internal diameter of conduits larger than 50 mm (2 in). 48 inches sweeps are preferred.

4) All conduits entering a building must be pitched to drain away from the building to avert water intrusion. Conduits entering through walls will be metallic and extend to undisturbed earth.

D. Joint Use Maintenance Vaults (MVs) are permitted, 4' x 6' minimum, traffic-rated where required. Conduits entering the MV are to be placed at opposite ends of a MV. Specify round COMMUNICATIONS covers, and equip with bonding inserts and struts, pulling eyes, a sump, an entry ladder, and grounding points.

E. Handholes (HHs) are allowed as pull points only, and not allowed for runs with more than (3) 4 inch conduits. Do not allow joint use HHs and specify that conduits are to be aligned on opposite walls at the same elevation. Specify round COMMUNICATIONS covers, traffic-rated where required.

9. OSP Backbone Cabling

A. PCFM must approve all designs. A detailed Communication site plan and backbone logical drawings will be required for all backbone cabling plans.

B. Cable insulation type, lightning protection and termination methods are important considerations when designing outside plant (OSP) cabling. CIRCA lightning protection solutions will be utilized on all copper multi-pair cables and all copper and fiber optic cables will be grounded.

10. Horizontal Cabling

A. PCFM must approve all designs.

B. Specify plenum cable unless home run conduits are installed in PCFM facilities.

C. In general, each station jack shall have (2) CAT6A cables, (1) data and (1) VoIP

D. A minimum of one duplex electrical outlet should be designed within 16 inches, but not closer than 8 inches, of every work area outlet.

E. Cable ID label will be a minimum 3 inches from termination point at patch panel and station jack.

F. Design a 12” service loop above each station jack in the accessible ceiling.
G. Design a 10’-0” service loop in the ladder tray above the equipment rack for each bundle of cables connecting to a patch panel.

11. Special System Devices
   A. Area of Refuge Phone – Design the phone outlet with one 4-pair Category 6A twisted pair cable terminated on a TIA-568B CAT6 jack.
   B. Blue Light Phone – Design the phone outlet with two (2) 4-pair Category 6A twisted pair voice cables terminated on a TIA-568B CAT6A jack. Call for a 1-¼ inch conduit to the Blue Light.
   C. Elevator Phone – Design each elevator cab with two (2) 4-pair Category 6A twisted pair cables per cab to the Elevator Control Room, terminated on a TIA-568B CAT6A jack. Coordinate jack location with Elevator Supplier.
   D. Wireless Access Point – Design each WAP outlet with (2) 4-pair Category 6A twisted pair cables. A Wireless enclosure will be designed as required and cabling will be terminated on (2) modular jacks in a biscuit box.

12. Testing, Identification and Administration
   A. Specify testing of Copper UTP cables.
   B. Specify that channel link for CAT6A cable is minimum of 6db headroom. Permanent link for CAT6A cable is minimum of 3db headroom.
   C. Specify that testing of Optical Fiber cables will conform to the requirements of TIA 568-C Tier II. In addition, OTDR Traces will be provided for all fiber testing bi-directional and power meter.
   D. Fluke 1800 DTX is recommended for CAT6A cable tests.
   E. Specify that Linkware software will be used for test results.
13. Graphic Diagrams:

A. The following section will show examples to follow for existing installations. All new work shall be a Berk-Tek Leviton Technologies product solution and be backed by a Lifetime Warranty. A preconstruction meeting with Chris Garcia will be required prior to start of construction to cover any installation best practices and/or changes. Please see figures 1-6 below. For TI and Legacy installs, match existing. For all new builds please reach out to Pima County ITD “TeleCable” Project Managers.

Figure 1: Standard Conference Room Layout
Figure 2: Pima County WAP Standard

**Part Numbers:**
- 2 port ivory surface mount biscuit Leviton (41089-2IP)
- Orange Cat6 jack Leviton (5EUIK-ROS)
- 48 port angled patch panel Leviton (68T56-N48)
- Berk-Tek LANmark SST CAT6A (11140408)

**Note:** If Berk-Tek is unavailable utilize General Cable GenSPEED 10M/TP Gen 5 CAT6A Orange (71521856).

(Approval to be given by Pima County FM Project Mgr)

**MAC address Label (Installed on AP device)**

**MAC: 2457**

**Ceiling Grid Label (Installed on Grid where cable is located)**

**WAP – 3001/3002**

- All Cabling must be labeled properly
- If the building is single story then label will read WAP-001, if it is a multiple story building then it will be labeled WAP-1001 (the first number being the floor the deep is located on)
- Locations that need to be labeled:
  - On both ends of the cable (cable wrap)
  - and on the patch panels
  - IDF label in window are of surface mount biscuit (if there are multiple IDFs)
  - The Ceiling Grid where the AP cabling is located
- The last 4 digits of the MAC address needs to be labeled on the WAP device itself.
- All labeling and faceplate layout standards must be followed unless specified by customer
Figure 3: Pima County CAT6A Data Standard

- All cabling must be labeled properly
- If the building is single story then label will read D-001 if it is a multi-story building then it will be labeled D-1001 (the first number being the floor the drop is located on)
- Locations that need to be labeled:
  - On faceplate in/to windows
  - On both ends of the cable (cable wrap)
  - On the patch panels
  - IDF label (if there are multiple IDFs)
  - All labeling and faceplate layout standards must be followed unless specified by customer

County Faceplate layout and labeling standard for Shielded Cat6A locations (Leviton/Berk-Tek)

Patch Panel Label: V-3001

Cable Wrap Label: V-3001

Cable Wrap Label: D-3001

Patch Panel Label: D-3001

IDF ID Label: IDF-1099 (required only when there are multiple IDFs in the area)

Facoplate Label: V-3001

Facoplate Label: D-3001

Part Numbers:
- Leviton 4 port angled stainless faceplate (43081-11A)
- Leviton Atlas X1 Cat6A XP Jacks Orange (6AUJK-RO6)
- Leviton Atlas X1 Cat6A XP Jacks Blue (6AUJK-RLB)
- Leviton 48 Port shielded unpopulated angled patch panel (8W5S6-H48)
- Berk-Tek LANmark-KTP SST Cat6A Plenum Cable Yellow (11140403)
- Berk-Tek LANmark-KTP SST Cat6A Plenum Cable Grey (11140402)

Note: If Berk-Tek is unavailable utilize General Cable GenSPEED 30MFTP Gen 5 CAT6A (Yellow 7151852/Gray 7151851). (Approval to be given by Pima County FM Project Mgr.)
Figure 4: Pima County Typical IDF Layout Standard

- **120V 20AMP QUAD RECEPTACLE on dedicated circuit.**
- **L5-20R receptacle on dedicated circuit.**
- **2-post 16" equipment racks.**
- **8" vertical wire manager.**
- **INSTALL PDU mounted in top 6" space of rack. PDU shall have L5-20R receptacle.**
- **TOG - GROUND BUS.**
Figure 5: Pima County Single 2-Post Rack Layout Standard

County Typical (1) 2-Post Rack/1-96

- Additional patch panel required once cable count reaches 76 locations
- Vertical Cable Managers - 8"x 7"
- PDU shall have L5-20R Receptacle
Figure 6: Pima County (2) 2-Post Rack Layout Standard

County Typical (2) 2-Post Rack/1-96 & Above

- Vertical Cable Managers
  - 8’ x 7’
- PDU shall have L5-20R Receptacle
Division 28 – Fire Alarm

1. Supplemental Requirements

A. All Pima County buildings will have a fire alarm system unless directed otherwise by the Project Manager. The design professional will provide a complete design. Performance specification will not be acceptable.

B. The fire alarm system design will include but is not limited to alarm initiating devices, voice evacuation equipment, control panels, auxiliary control devices, annunciators, power supplies, battery calculations, voltage drop calculations and wiring.

C. When integrating with an existing fire alarm system, the design professional will include all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. needed to integrate the existing fire alarm system with the new fire alarm system. This includes, but is not limited to, additional power supplies, initiating devices and circuits, signaling devices and circuits, monitoring devices and circuits, auxiliary control and related devices such as door holders and their control, smoke damper control, fan shutdown, etc. The existing fire alarm system will be integrated with the new fire alarm system such that the existing fire alarm system's functionality, integrity and annunciation will be equivalent to preconstruction conditions unless noted otherwise. The functionality and integrity will be maintained during construction. The entire system will be able to be completely reset from any single reset location point.

D. The fire alarm control panel will be monitored by Pima County Facility Management (PCFM). Design professional is to include notes and directives stating the Contractor must coordinate with and notify the PCFM Project Manager three weeks prior to activation date and provide the FA panel information required by PCFM.

E. When required by the project, the design professional will design an emergency voice alarm communication system. The system will provide alerting in the building, and if required by Pima County, interface with distributed recipient mass notification system.

   1) Audio amplifiers (when required by the project) will provide a single channel audio power at 25/70 volts RMS for distribution to speaker circuits.

   2) Each initiating zone or intelligent device will interface with an emergency voice communication system capable of transmitting a digitized voice message to all speakers in the building.
3) Actuation of any alarm initiating device will cause a digitized message to sound over the speakers. Design the message to be repeated four (4) times.

4) Specify a microphone to allow paging through speaker circuits.

5) Designer will indicate a flush mounted jack in a stainless steel plate at locations required by NFPA 72 and as coordinated with Pima County.

F. When required by project, the design professional will design a two-way talk path for the fire department’s use, from the voice command center to the secondary fire alarm attack entrances, elevator lobbies, primary and backup power rooms and the entrances to all enclosed stairways.

2. System Control Panel

A. Acceptable Manufacturers:

1) Fire-Lite.

2) Edwards – EST.

3) Simplex or other if expanding or modifying an existing system.

B. If expanding an existing system and a majority of the existing system is being modified or if an existing system is in need of replacement, design professional should confirm with the PCFM and design the system incorporating one of the preferred options.

C. Design a modular, power-limited control panel with surface wall-mounted enclosure.

D. Design Signaling Line Circuit (SLC) loops to 80% of the maximum device capacity.

E. System battery capacity will be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 15 minutes, plus 25% spare capacity for future devices.

F. Specify dual phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator will be capable of transmitting each device address point in a format compatible with the PC central station receiver. Communicator will be fully supervised and will operate on loop start phase lines ahead of the building PBX system. At sites where a copper phone service is not available, the design will include a cell phone dialer.

3. Signaling Line Circuit Devices

A. Specify analog photoelectric or analog ionization detectors as required.

1) Specify duct-type smoke detectors with sampling tubes and mounting hardware to match the duct to which it is attached.

2) Specify a remote alarm LED indicator device if detector is not visible from a floor. If detector is located above a suspended ceiling, specify a remote indicator in ceiling directly below detector with a white single-gang faceplate labeled “Duct Smoke Detector”. Label to indicate zone/loop and device number.

B. Specify combination rate of rise and 135°F fixed temperature analog thermal type sensors as applicable.
C. Specify manual pull stations to be addressable, single action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Specify tamperproof covers for fire alarm pull stations in public areas. Specify pull stations with clear Lexan tamper resistant cover with integral 9V battery powered alarm that sounds when shield is lifted.

4. Notification Devices
   A. Design professional will locate audio, visual and combination audio/visual devices per NFPA 72 and as coordinated with Pima County.
   B. Audio device sound levels will be designed to provide audio levels 15db above ambient sound levels for the space where that are installed.
   C. Visual devices will be high intensity xenon strobe or equivalent under a lens.
   D. Acceptable notification devices include wall/ceiling mounted strobe lights, speakers, horn/chimes, combination speaker horn/chimes, and combination speaker strobes.

5. NAC Extender Panel (NEP):
   A. Specify that each NEP will be a self-contained remote power supply within a surface lockable cabinet. Battery capacity will be sufficient for operation for 24 hours in a non-alarm state followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NEP will provide a minimum of up to 4 outputs, 2A continuous, or 6A full load total capacity.

6. Graphic Annunciator
   A. When required by the project, the design professional will specify a color graphic annunciator to allow the control panel to annunciate the status of the control panel and every peripheral device.

7. Fire Alarm Cabling
   A. Specify that all fire alarm wire/cabling will be installed in conduit, and that conduit and junction boxes will be painted red.
Division 28 – Security Systems

1. Supplemental Requirements
   A. Pima County buildings will be equipped with integrated security systems, consisting of access control, intrusion detection, and video surveillance systems, or a combination of these, as identified by PCFM.
   B. The design professional will provide a complete design for each system. Performance specification will not be acceptable.
   C. Designs will incorporate all materials, hardware, software, licensing, fabrication, programming, testing, and documentation in conformance with manufacturer’s documentation, PCFM requirements, all applicable Codes and standards, and the requirements of the Authorities Having Jurisdiction for the implementation of complete and functional systems.
   D. The design professional will coordinate all related items with stakeholders, PCFM, and other design disciplines, including the specification of programming and all software and hardware, connections, and interfaces. Coordinate conduit, pathways, and power requirements for security devices with the electrical engineer.
   E. Coordinate with PCFM to identify all network and telecom connections for access control, intrusion detection, and video surveillance systems in any PC telecommunications room.

2. Access Control System
   A. The system design intent is a perimeter envelope that will have access control functionality primarily at perimeter doors, elevators, elevator lobbies and other specific interior doors and areas as identified by PCFM. Specify the access control and video surveillance systems to functionally integrate, thus allowing a visual image of a perimeter breach where cameras are placed. An example would be a “door forced open” alarm where the associated camera would show a visual image of the door in alarm condition.
   B. The access control system standard is DSX, which is utilized in the majority of the County Buildings. Some existing buildings may still have the OnGuard Enterprise Access Control System by Lenel in use and the design professional will coordinate with PCFM if the remodel should upgrade to the DSX. The design professional will coordinate with PCFM to ensure that all equipment/devices proposed for the system meet Pima County standards.
C. Specify that access controlled doors and perimeter “exit doors” to have door position switches that seal off the perimeter during off hours. Specify an alarm condition at the monitoring station if this perimeter is breached. Specify that in case of an emergency all of the access-controlled doors can be locked down.

D. Specify system programming so that certain perimeter doors may be unlocked during regular hours and while other doors are controlled by credentials and schedules for off hours access.

E. When specifically required by PCFM, the access control system must be capable of fully supporting elevator cab card readers which can restrict access to certain floors based on programmed access levels. The system designer will coordinate with the elevator vendor to ensure design, installation, and programming for this functionality, and that elevator travel cable carries the wiring needed.

F. Specify that alarm signals from the system will register at the designated monitoring station(s) as an alarm. The alarm signal will include the time, date, location, and ID number of the alarm point.

G. Coordinate with PCFM for the specification of wired versus wireless devices for each project.

H. When integrating with an existing system, the design professional will specify all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. needed to integrate the existing access control system with the new access control system. This includes, but is not limited to, additional power supplies, card readers and circuits, electronic door hardware, door position switches, auxiliary control and related devices such as surveillance cameras, motion detectors, etc. Specify that the existing access control system will be integrated with the new system such that the existing system's functionality, integrity and annunciation will be equivalent to pre-construction conditions unless required otherwise by PCFM. Specify that the existing system will be maintained and operable during construction. The entire system of new and existing components will be able to be completely reset from any single reset location point.

I. Door Hardware:
   1) Coordinate with the Door Hardware section of the Design Standards for the door hardware that will be specified.
   2) Design should include HES electric door strikes (9000 series) at each door with card access. Utilize door strike to fit application.

J. Credential Readers:
   1) Specify hardwired networked credential reader modules as needed for the door hardware sets. Specify NFC-compatible readers that read access control data from both 125 kHz and 13.56 MHz contactless smart cards. Use HID iClass SE and Schlage Mifare (Si or SiK) as basis of design. Specify credential readers capable of being configured at the reader with a handheld programming device and remotely operated with the following integrated software partners:
      a. 13.56 MHz Smart card credentials: Secure section (Multi-Technology and Smartcard): aptiQ MIFARE Classic, MIFARE DESFire EV1, PIV and PIV-I Compatible, iClass SE/SEOS.
b. Dual credential reading capabilities credential card or fob and PIN.

K. Power Supplies:

1) Specify that access control peripheral devices will be powered by Altronix, SDC, Allegion brands, or Assa Abloy brands power supplies. Specify sealed lead acid (SLA) battery back-up sufficient for 4 hours, standby plus 25 activations for all DC locks.

2) Coordinate with the project electrical engineer for power connections where needed, and with the fire protection engineer where fire alarm connections are needed.

3) Design all power supplies to permit simultaneous continuous-duty activation of all door locks, with an additional minimum 20% capacity on each supply. Calculate voltage drop to locks and size lock control wiring to provide proper lock operation.

L. Provide fire alarm interface as required per NFPA 72. A connection from the access control system to the fire alarm system to respond to this input of an emergency condition as per all local and national codes, ordinances, statutes and/or rules, guidelines and directives of the governing Authority Having Jurisdiction.

M. Design outdoor equipment to have lightning and surge protection. Ditek Corporation is the design standard.

N. Wire and Cable:

1) All cables will be U.L. Listed, plenum (CMP) rated and appropriate for the application.

2) Design professional will design proper cable rods and J-hooks supports where conduit, cable trays and/or cable paths are not provided. Cable will be run free air above ceiling areas with plenum rated cable. Firewall penetrations must be coordinated with the architect and identified on construction documents.

3) Specify that the contractor will follow the manufacturer's recommendation for cabling. Show wire and cable sizes, number of conductors, shielding, or other data on the construction documents. Cabling will be sized and installed according to local electrical code requirements.

O. Specify that all security equipment, junction boxes, terminal cans, etc. installed in publicly-accessible areas will be utilize tamper-resistant mounting hardware.

P. Where required, the system design will specify seismic restraint for all equipment, including equipment racks, consoles, etc.

Q. Design earth grounding of equipment as required by equipment manufacturer.
3. **Intrusion Detection System**

   A. **DSC Maxsys Series** is the IDS basis of design for both wired and wireless systems. Coordinate with PCFM for the specification of wired versus wireless devices for each project.

   B. A minimum level of surveillance will be deployed at each Pima County facility. The design professional will need to meet the level of surveillance as directed by PCFM prior to starting the design.

   C. Design and specify the IDS system such that any alarm will be reported to and monitored by PCFM.

   D. Coordinate the IDS control panel location with the architect and PCFM.

   E. **Wire and Cable:**
   
   1) Design proper cable supports (rods or J-hooks) where conduit, cable trays and/or cable paths are not provided. Specify plenum rated cable.

4. **Video Surveillance System**

   A. When integrating with an existing system, the design professional will include all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. existing VSS system with the new system such that the existing system’s functionality, integrity and annunciation will be equivalent to preconstruction conditions unless noted otherwise. The functionality and integrity of the existing system will be maintained during construction.

   B. **System Equipment:**
   
   1) **Axis** is the VSS basis of design. **Samsung** is also acceptable.

   2) New cameras will be IP format, with wide dynamic range and megapixel resolution(s) and will provide high definition fluid-motion color video. Analog cameras will not be specified, and when integrating with an existing system the design professional will coordinate with PCFM regarding replacement of existing analog cameras. Specify the following basic functionality at a minimum. Detailed definitions of each functional requirement are to be as directed by PCFM.

   a. ONVIF Compliant
   b. Wide Dynamic Range
   c. Day/Night Capability
   d. Motion Detection
   e. Analytics Capability
   f. Standard Mounting

   3) The following camera types will typically be specified:

b. Minimum 5 Megapixel (1080p) exterior wall / pole mount fixed dome type camera, integral IR illumination and varifocal lens, color/low light, BW capable.

4) Coordinate with PCFM regarding any specialty cameras as needed for a project specific application.

5) All IP network cameras will utilize Power over Ethernet (IEEE 802.3af) except outdoor PTZ’s (if required). Existing and replacement PTZ camera will utilize existing power source or new power source as identified.

6) Coordinate with PCFM as to the standardized platform for the video management software.

C. All cameras will be designed and specified with the manufacturer’s tamper-resistant hardware and mounting kits for lay-in or hard ceiling types, wall- or pole-mounted locations, or pendant-mounted locations as needed. Specify supports to building structure, not to other systems or their conduits.

D. For exterior cameras, design and specify environmentally-controlled weather-resistant camera enclosures designed for hot and cold climate applications where temperatures can exceed 100ºF.

E. Media converters may be used to convert a signal to travel on Ethernet cable where needed. Many types and applications are available for use and will be acceptable from Network Video Technologies or Comnet brand.

F. Any camera or IP device that will have a cabling length of more than 300 feet will require an Ethernet extender and/or fiber. Ethernet extenders will be placed in approved locations when used, and devices will not be hidden in locations that cannot be easily accessed and maintained.

G. Wire and Cable:

1) Except as specifically noted to the contrary herein, all primary camera cabling will be unshielded twisted pair (F/UTP) Category-6A. Design professional will coordinate with PCFM cabling will be provided by the low-voltage IT/telecom cabling contractor or security contractor.

2) Unless specifically directed by PCFM, all cable runs for security cameras will be one (1) Category-6A unshielded twisted pair (Cat-6A F/UTP) cable to each camera location terminated in a Cat-6A RJ-45 modular female jack at the camera location. The demarc will be the RJ45 female jack at the camera. Cat-6A F/UTP cables will be terminated in the appropriate TR on Cat-6A patch panels.

3) Specific Cat-6A F/UTP cabling and labeling information is referenced in the PCFM Division 27 cabling design requirements.
General Commissioning Requirements

1. General Requirements
   A. Commissioning is a quality-focused process for achieving, verifying, and documenting that building systems are installed and perform functionally as intended. The GC and Trade Subcontractors shall provide the quality control for the installation, startup, checkout, and testing of the applicable systems within the commissioning scope. The commissioning process provides independent review by the CxA and qualitative functional performance testing witnessed by the CxA in order to formally observe and document that the quality control efforts are completed.
   
   B. New and remodeled facilities will be commissioned by a third-party commissioning authority (CxA), contracted by Pima County. The CxA is the authority on commissioning results and other commissioning program elements and will assist the General Contractor (GC) and Trade Subcontractors with coordinating commissioning activities. The CxA will witnesses the activities on behalf of Pima County.
   
   C. Projects are to be commissioned per the applicable International Energy Conservation Code (IECC) requirements, unless the project is achieving LEED Certification to which then the applicable LEED Commissioning Requirements are to be followed.
   
   D. Systems to be commissioned include:
      1) Heating, ventilation, air-conditioning, and refrigeration systems and associated controls.
      2) Lighting and controls including occupancy and photo sensors, output, color, and scene controllers.
      3) Domestic hot water systems.
      5) Emergency Power Systems including generators, transfer switches, central emergency lighting inverters, and load centers.
      6) Building enclosure and any other special systems identified by Pima County on a project-specific basis.
   
   E. Fire/life safety, elevators and security systems are excluded from commissioning and are to be tested by Contractor/sub-contractor/AHJ as coordinated by Pima County.
F. System Testing and Balancing is to be performed by the GC and reviewed by the CxA. Reference Division 23 HVAC for Testing and Balancing requirements.

2. General Execution Requirements

A. General Contractor shall account for and facilitate coordination between the CxA and the Trade Subcontractors including the controls sub-Contractors. All commissioning tasks and requirements are to be incorporated into the GC’s project schedule.

B. CxA will review relevant submittals and RFIs during construction and report findings to PCFM.

C. The GC and Trade Subcontractors shall attend a commissioning kick-off meeting lead by the CxA and shall review the commissioning plan issued by the CxA. The GC and Trade Subcontractors shall also attend periodic commissioning meetings as required by the CxA.

D. The GC and Trade Subcontractors shall submit to the CxA all applicable completed commissioning forms and plans for system and equipment installation verification, startups, and pre-functional checks (including HVAC controls and TAB), as required in the commissioning specifications and/or the commissioning plan.

E. The pre-functional checks for the HVAC control system shall include complete point-to-point checks of all control points with the control system software graphics.

F. The Trade Subcontractors shall complete and document the installation verification, startup and pre-functional checks for all systems and equipment (no sampling will be permitted).

G. The GC and Trade Subcontractor shall submit a comprehensive Training Plan (with specific training agendas) for review by the CxA and Pima County, prior to conducting any training. The Training Plan shall meet the specific requirements in the contract documents and specifications for each applicable system to be commissioned.

3. Commissioning Scope of Work (CxA)

A. DESIGN PHASE COMMISSIONING (OPTIONAL)

1) Prepare, schedule, conduct and document the commissioning kick-off meeting to review the initial Commissioning Plan and explain the commissioning scope, process, roles, and responsibilities.

2) Develop and maintain the Commissioning Schedule and Plan. The schedule will need to be coordinated with the GC.

3) Communicate and optimize Pima County’s Project Requirements (OPR).

4) Review 50% design drawings and 90% construction documents with respect to the Basis of Design (BOD).

5) Review submittals, shop drawings, and equipment detail sheets to ensure compliance with specifications.
B. CONSTRUCTION PHASE COMMISSIONING

1) Coordinate and host commissioning meetings.

2) Review of key construction submittals such as the main HVAC and DHW equipment, the TAB Plan, EMCS/BAS controls, and lighting controls sequence of operations, concurrently with the engineer of record (EOR), and provide written review comments to the EOR for inclusion in the returned submittals. Review of other submittals as needed, to become familiar with the equipment being installed.

3) Review the GC’s project schedule related to commissioning activities and durations at the start of and throughout construction and provide comments to the County and Contractor.

4) Visit the project site to review the systems installation and readiness of the systems for startup, controls checkout and TAB, and issue Commissioning Field Observation Reports.

5) Review all Contractor completed pre-functional checklists including:
   a) HVAC and Plumbing equipment startup forms.
   b) Completed EMCS pre-functional checkout forms.
   c) Completed lighting controls pre-functional checkout forms.
   d) HVAC TAB Report.

6) Witness startup, testing, adjusting, and balancing.

7) Develop functional performance test forms and update per any review comments from the team.

8) Implement building system functional performance testing & verification.

9) Witness and document the functional performance tests conducted by the Contractors and provide input for the resolution of issues and recommendations for improvements.

10) Witness a backcheck sampling of the Testing and Balancing Subcontractor’s TAB measurements for areas selected by the CxA for approximately 20% to 40% of the associated TAB measurements or what can be accomplished in no more than 1 day of onsite time. If the TAB backcheck yields results that are outside the TAB tolerances for more than 5% of the sample, the TAB shall be considered incomplete.

11) Document and monitor issues discovered by Commissioning through to resolution or acceptance by Pima County.

12) Maintain and distribute Commissioning Field Observations Report and Issues Log for Commissioning observations, issues, and recommendations.

13) Throughout the commissioning process, the GC and Trade Subcontractors shall correct any commissioning issues identified by the CxA and recheck or retest the systems without delay at no additional cost to Pima County.

14) Review Operations and Maintenance Manuals for all building systems.
15) Provide a final Commissioning Report to the County, including all commissioning documentation and the final Commissioning Issues and Resolutions Log.

C. OPERATIONAL PHASE COMMISSIONING (OPTIONAL)

1) Continue monitoring system performance post-occupancy.
2) Assist with warranty management.
3) Provide ongoing operator training.
4) Assist with deployment of preventive maintenance plan.
5) Provide Pima County all passwords and root access to BMS and Lighting Control Systems to allow future modifications to programming.