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CONSULTANT GUIDELINES

INTRODUCTION

The Cherry Creek School District strives to help children and young adults become tomorrow's leaders by providing public education "Dedicated to Excellence" and second to none. The District's mission is, 'To inspire every student to think, to learn, to achieve, to care." The Board of Education believes that scholastic achievement and personal performance can be enhanced by providing safe, intellectually stimulating schools. These intellectually stimulating schools not only provide programs that enable students to achieve their maximum individual potential, but also are high-quality learning environments which enrich the learning process.

For many years, the Cherry Creek School District has been committed to providing first-class educational facilities of the highest quality while being constructed at reasonable cost. The School District believes that the successful formula for providing "first-class educational facilities" is to assemble the best team of design consultants, educators, facility planners, maintenance and custodial staff, and parents and to encourage effective communications between all parties of the team.

This document entitled CONSULTANT GUIDELINES is an attempt by the School District to streamline the communication process by summarizing, in written form, critical information required by design consultants to "successfully" design all types of educational facilities and support facilities including new buildings as well as additions, renovations, and alterations/maintenance of existing facilities.

The information and criteria presented in these Consultant Guidelines is not to be construed as limiting creative design or functional and economical considerations, but to assist the design professionals by providing a degree of uniformity for all the Cherry Creek facilities and thereby assist the School District in their effort to standardize facilities and facilitate ease of maintenance.

The information contained in this document is divided into three major categories. Those categories/sections are as follows:

- DESIGN GUIDELINES
- DESIGN SERVICES/DESIGN PROCESS
- TECHNICAL GUIDELINES

Included in the DESIGN GUIDELINES are topics such as School District design philosophy, accessibility, acoustics, maintainability, energy efficiency/sustainability, flexibility, safety and security, and site selection/site development guidelines.

The DESIGN SERVICES/DESIGN PROCESS portion of this document outlines contractual issues and responsibilities of the School District and the design consultant for all phases of the design process.

The last and most extensive section of these guidelines is the TECHNICAL GUIDELINES. The detailed information contained in this section is geared toward assisting the design consultants in preparing bid and construction documents for projects. These technical guidelines generally follow the Construction Specifications Institute (CSI) Manual of Practice and Master Format (2004) of specification sections. These

sections are greatly abbreviated and aimed at providing only the "basic technical" information the design consultant will need to prepare complete specifications and contract drawings. Information in each section is broken down into the following categories:

- Summary - (definition of what the section includes)
- Reference standards/minimum criteria
- Submittals
- Restrictions/critical criteria
- Acceptable manufacturers and products

The DESIGN GUIDELINES and TECHNICAL GUIDELINES are intended to be used as advisory documents only. Design consultants assume full professional responsibility for research, design, engineering, regulatory compliance, and other requirements defined by statutes and prevailing standards of professional care. Under no circumstances are the TECHNICAL GUIDELINES to be used as master specifications in the preparation of construction documents. Specific products identified in the TECHNICAL GUIDELINES are intended to provide a level of quality and acceptable minimum criteria for satisfying a particular need of the Cherry Creek School District. It is the responsibility of the design consultant to verify that listed products and criteria are applicable for the particular design solution under consideration by the design professional.

Should any information or item contained in this document be contrary to current state-of-the-art practices and materials, it is the responsibility of the design consultants to inform the School District of such items and provide information on alternatives.

This document represents the Cherry Creek School District's attempt to assemble, in written form, guidelines for design professionals. The School District welcomes any questions, comments, criticisms, and requests for revisions in an effort of providing better and more accurate information for design professionals. All feedback should be directed in writing to Mr. David Henderson, Deputy Chief, Operations, Cherry Creek School District, 9301 E. Union Avenue, Greenwood Village, CO 80111, telephone number (720) 554- 4455.

Cherry Creek School District intends to review the comments, questions, and requests for revisions on a periodic basis and update this document in order to furnish the most complete and reliable data of current criteria for the School District.

DESIGN GUIDELINES

A. SCHOOL DISTRICT DESIGN PHILOSOPHY

The Cherry Creek School District believes in the importance of the physical environment as a major factor in facilitating the learning process. The School District design philosophy is that new facilities should be attractive and stimulating while being functional, economical, and sustainable. They should be state-of-the-art and harmonize with the environment without being experimental or trendy. Designs for additions and modifications to existing buildings should reflect, enhance, and unify the existing visual image and environment.

B. ACCESSIBILITY

All new construction shall be designed to provide full accessibility as defined by the International Building Code (IBC), the ICC/ANSI A117.1 Guidelines, and ADA Architectural Guidelines (ADAAG). Full accessibility is to be provided not only to students, but also for teachers and citizens as well.

For projects that involve additions to existing facilities or remodeling/renovations to those same facilities, every effort shall be made to provide full compliance with the IBC, ICC/ANSI A117.1, and ADA in the portions of the buildings being remodeled and in the new additions. Where it is technically infeasible to provide full compliance, the design consultant, using his best professional judgment, shall provide improved accessibility per the requirements of the International Existing Building Code. Priority shall be given to providing unimpeded access to all educational spaces and restrooms/toilet facilities.

C. ACOUSTICS

Appropriate acoustical design is extremely important in all types of educational facilities. The design consultant shall provide acoustical separation or isolate noise-generating activities, areas, and equipment. The spaces shall be designed with appropriate acoustical separations, acoustical absorption and reverberation time for all intended activities and the various acoustical volumes. As a minimum standard, the design of classrooms and other core learning spaces shall meet the requirements of "Prerequisite #3, Minimum Acoustical Performance, LEED for Schools for New Construction and Major Renovations, 2007." Special attention shall be paid to providing vibration control and sound isolation for mechanical and electrical equipment, particularly mechanical rooftop units placed above occupied spaces.

D. MAINTAINABILITY

The appropriate selection of materials and equipment in educational facilities is extremely important in terms of their longevity and cost associated with their maintenance. Design consultants shall work with the School District to prepare life-cycle cost analysis of various systems and materials. It is also important to incorporate durable materials that are resistant to vandalism and abuse, provide adequate access to service, and repair and replace major pieces of equipment (boilers, fans, etc.) and building components (walls, floors, roofs, window glass, doors, etc.). Attention should also be given to facilitate service and repair of mechanical and electrical equipment.

E. ENERGY EFFICIENCY

The cost of operating school buildings is extremely critical in terms of the School District budgets. Every effort shall be made to reduce energy cost through energy conservation and water conservation. Buildings shall be designed to meet the requirements of the current adopted International Energy Conservation Code and incorporate natural daylighting in all instructional spaces where economically feasible. The School District encourages energy efficient design and will consider incorporating energy conserving equipment and design techniques, provided these techniques can be accomplished within the construction budget and have a reasonable lifecycle cost. At the beginning of each new school project or major addition/renovation project, the design consultant shall establish, jointly with the School District, a "reasonable" energy target (BTU's per gross square foot and watts per gross square foot of building). In addition, the design consultant together with the School District will review the criteria contained in "LEED for Schools for New Construction and Major Renovations" to determine which requirements will be incorporated into the project and whether the project will be designed to meet the minimum requirements of a "Certified LEED Project."

F. FLEXIBILITY

Educational philosophies and programs are constantly changing to reflect the changing society we live in. Schools must be designed to be flexible in order to adapt to constantly changing educational philosophies and teaching techniques. The facility design should allow for cost-effective interior modifications of school buildings without sacrificing functionality and acoustics. Facilities within the building should also be designed to serve multiple functions including community centers, meeting places, public recreation, and other after-hour group activities. Appropriate site master planning should also facilitate flexibility. The building should be located on the site to facilitate ease of expansion of the building in multiple directions.

G. SAFETY AND SECURITY

The safety and security of all students, teachers, and staff in Cherry Creek Schools is of utmost importance. Design of school facilities and selection of materials will promote the safety of the occupants. For example, non-slip walking surfaces shall be incorporated in both interior corridors and exterior sidewalks. Visual Supervision (both electronically and physically) of students shall be an important concept in the shaping of spaces and environments related to educational facilities. The design consultant shall coordinate with the School District the design and location of video surveillance camera systems and card access systems at all district buildings. The layout of the site and design of the building shall minimize ice build-ups at building entrances and at pedestrian ways, and the design of the exterior facade and placement of landscape materials shall discourage unauthorized access to the roof. Site design incorporating reasonable separation for pedestrians, busses and auto traffic is critical and during construction of occupied school buildings, safety of students is the primary concern. The construction traffic shall not conflict with student use in any way.

H. RECOMMENDED DESIGN HEIGHTS

Design mounting heights for equipment and fixtures for student areas in school buildings are listed in the chart below. These recommended heights are intended to supplement, but not supersede, the requirements of the IBC, ADAAG, ADAAG recommendations for accessibility standards for children's environment, ICCI/ANSI A117.1, and other applicable codes. All dimensions are measured from the finished floor.

ITEM	PRE-SCHOOL	ELEMENTARY SCHOOL	MIDDLE SCHOOL & HIGH SCHOOL
Lavatories (rim)	30"	34" max.	34"
Water closets (seat)	12"	15" (17" ADA)	19"
Urinals (rim)	14"	17" max.	24" (17" ADA)
Shower head (control)	NA	NA	42"
Shower seat	NA	NA	19"
Drinking fountains (spout)	30"	30" (38" adult)	38" (36" ADA)
Eyewash	NA	NA	36"
Mirror (bottom)	34" max.	34" max.	38" max.
Soap dispenser (outlet)	32"	32"	38" max.
Toilet paper dispenser (outlet)	17" (1.5" min. below grab bar, 15" min. above floor)	19" (1.5" min. below grab bar, 15" min. above floor)	24"+/- (1.5" min. below grab bar, 15" min. above floor)
Hand/hair dryer (nozzle)	NA	NA	48"
Sanitary napkin dispenser (coin slot)	NA	40"	40"

ITEM	PRE-SCHOOL	ELEMENTARY SCHOOL	MIDDLE SCHOOL & HIGH SCHOOL
Grab bar (center)	25"	33"	36"
Paper towel dispenser	34"	34"	38"
Sinks - work areas (top)	30"	30" (34" ADA adult)	34"
Handrails (top)	26" (34" adult)	28" (34" adults)	34"
Standing counter (top)	30"	30"	36" (34" ADA)
Sitting counter (top)	24"	27"	30"
Typing surface (top)	**NA**	26"	27"
Chalkboard/Markerboard (bottom)	20"	24"	36"
Room identification signs (top)	60"	60"	60"
Fire extinguisher cabinet (handle)	48"	48"	48"
Clock, bell, intercom speakers (center)	88"	88"	96" (88" @ 8' ceilings)
Horn/strobe (bottom)	80"	80"	80"
Thermostat (center)	60"	60"	60"
Electrical switch	48"	48"	48"
Fire alarm pull	48"	48"	48"
Elevator call button	48"	48"	48"
Electrical/Telephone/Data receptacles			
• Standard (bottom)	15"	15"	15"
• Wall (bottom)	48"	48"	48"
• Counter (bottom)	6" above counter	6" above counter	6" above counter

I. SITE DEVELOPMENT GUIDES FOR SCHOOLS

The following standards provide data regarding the design of school sites:

1. SITE TOPOGRAPHY GUIDES:

	MAXIMUM SLOPE	*MINIMUM SLOPE*
a) Driveways	6% (without attached sidewalks)	1.5%
b) Parking areas	per ADA/ANSI	1.5%
c) Pedestrian sidewalks	per ADA/ANSI	1.5%

	MAXIMUM SLOPE	*MINIMUM SLOPE*
d) Grassed play fields	3%	2%
e) Grass swales	10%	3%
f) Terraces, embankments	25%	2%
g) Play pads	3%	1.5%
h) Tennis courts	1%	1%
i) Athletic fields	2.4%	1.6%
j) High school football	18" crown	18" crown

2. DRIVEWAY, PARKING, SIDEWALKS:

a) School bus circulation

• One way traffic	16' minimum width drive (24' min. if fire lane)
• Two way traffic	24' minimum width drive
• Inside turning radius	35' minimum
• Outside turning radius	50' min (one-way traffic) 60' min (two-way traffic)
• Bus length	40'

b) Parking lot design (verify if design needs to meet City of Aurora standards if location in Aurora)

• Preferred parking configuration	90°
• Parking spaces	disabled per IBC/ICC/ANSI A117.1 standard: 9' x 18'
• Drive aisle width	24' minimum
• Separate drop-off lane	in front of building from parking lot.
• Parking islands	keep to a minimum

c) Pedestrian walks

• Ramps and curbs	per ADA/ANSI
• Minimum width	6' (8' preferred)

3. OTHER REFERENCED DOCUMENTS: Consultants should refer to the School District's most recent Educational Specifications for elementary, middle, high schools and other special schools/support facilities for more specific criteria relating to site elements. The site design should also incorporate specific requirements of the jurisdiction within which the facility is located. These would include Arapahoe County or the cities of Aurora, Centennial, or Greenwood Village.

J. SITE SELECTION CRITERIA FOR NEW SCHOOLS

Occasionally, the School District will request the services of a design consultant to assist in the analysis and selection of the school sites. The following criteria are used by the School District to analyze potential school sites:

1. SIZE AND SHAPE OF SITE

The net useable area of the site should be a minimum of 1O acres for an elementary school, 24 acres for a middle school, 80 acres for a high school, and 11**O** acres for a combined middle school/high school. Note that these acreage requirements exclude areas of the site which are extensively hilly, composed of setbacks or easements, required for on-site detention of storm water, etc.

The ideal school site will be rectangular in shape no further from square than 3 by 5 proportions. Primary site access would be on the long side of the rectangle. The overall site would slope uniformly and would have no other features (easements, access limitations, flood plains, etc) which might reduce the usefulness of the site or constrain its planning.

2. LOCATION

The selected site would be central to the population served, while being located suitably with respect to

other schools in the School District. The site would be favorably located, relative to off-site amenities such as libraries, recreational facilities, fire stations, and other public facilities and services.

3. ENVIRONMENTAL FACTORS AND NEIGHBORHOOD IMPACT

The impact of this land use on neighboring properties should be considered. Impact mitigation measures and their cost should also be studied.

The site should have a high percentage (85% or more) of reasonable topographic slope (2%-8%). Slopes lower than 2% will not drain properly; slopes higher than 8% are too steep to use efficiently given the vertical slope limitations. Drainage onto and off of the site should be manageable, ideally, directly to a regional drainage system. Otherwise, the cost of constructing on-site detention and stormwater management must be added to the cost of the site.

The site should not be in a 100 year flood plain; although this is manageable for some site uses (playing fields, parking lots, etc.), it is never desirable. Wetlands on the site should be minimal or non-existent.

The site should slope generally south to provide good sun exposure for snow melting with no major obstacles to good solar exposure. The site should not be excessively windy. The site should have good views for orientation of major public spaces, as well as good views onto the site to allow for easy observation and after hours surveillance.

Soils should not be expansive (if possible) and with appropriate depths of topsoil on the site. It should be feasible to grade the site as required and yet obtain a balance of cut and fill on the site. Ground water is not desirable within 12 feet of the surface. Other miscellaneous items such as archeological artifacts, proximity to industrial or utility uses, and railroads or major highways can deduct from the desirability of the site.

4. ACCESSIBILITY AND TRAFFIC FLOW

Ideally, an elementary school should front on a collector street and a secondary school site should front on two collector streets. If a secondary school has only one street available, two entrance locations (one for busses and one for automobile traffic) should be available on the long side of the site with adequate separation to allow safe full motion access. These collector streets should lead directly to an arterial street at a point controlled by traffic lights.

Relationship to non-school intersections should be safe and conducive to circulation. Streets should not have horizontal or vertical curves which inhibit safe circulation. Arrangements should discourage U-turns, drop-offs on the opposite side, and on-street parking-.

Pedestrian access should be on sidewalks with a slope of no more than 5% (ADA/ANSI requirement). Pedestrian crossings should be clearly visible and protected by traffic lights or flashing crossing signals. Pedestrians should not have to cross on-site bus or car drop-off areas for normal access to the school.

5. UTILITIES AND PUBLIC SERVICES

To minimize investment in off-site utility work, all public utilities should be in place at or near the site boundary at the time of development. All such utility systems should have adequate capacity to carry the load of the proposed new school. Existing taps or connection points (if any) should be in appropriate locations.

Desirable secondary school sites might be near the following public safety or cultural amenities: fire station, police (or sheriff) substation, hospital and/or ambulance dispatch, public transit, museums, auditoriums, and social services offices.

6. COST OF LAND

The total cost of land acquisition by the School District should be as low as possible. Total cost should account for land purchase plus all special access requirements, participation fees, off-site extensions of utilities, roads, etc.

7. DEVELOPMENT COSTS *(A catch-all category)*

This category includes any other features or factors which might add to the cost of developing the site. Examples might include excessive grading, long frontages on roads to be developed, internal drainage difficulties requiring special treatment, etc.

8. LAND USES AND ZONING

The site should be platted, zoned correctly, incorporated into the appropriate city and/or other improvement districts, and have the appropriate neighboring uses.

DESIGN SERVICES/DESIGN PROCESS

A. CONSULTANT AGREEMENT

For most projects, the Cherry Creek School District uses the American Institute of Architects, Owner Architect Agreement B-141 - 1997 Parts 1 and 2 with modifications. A copy of that document with the standard modifications is attached as Appendix A1. This document contains the general responsibilities, obligations, and other requirements of both the consultant and the School District for accomplishment of the work.

For unique professional services and special types of work, i.e. projects involving technology upgrades, Cherry Creek Schools may choose to accept the consultant's project scope letter in lieu of a standard agreement.

In order to assist the consultant and the School District in determining the specific scope of work to be included in the Owner-Consultant Agreement, the District may also use AIA Document B163, Standard Form of Agreement between Owner and Architect for Designated Services, 1993 Edition to assist in defining the specific scope to be accomplished. A copy of that document is attached as Appendix A2.

B. REFERENCED STANDARDS OF PROFESSIONAL CARE

Cherry Creek Schools realizes that it is impossible to define all the critical data and information required to accomplish the design and construction of new and renovated facilities in this manual. To supplement the information contained in this document, other information, recommendations, and latest standards/ document editions of the following organizations shall apply:

- AIA Architects Handbook of Professional Practice
- AIA Architectural Graphics Standards
- AIA/AGC Guidelines for Better Communications and Understanding Within the Construction Industry
- CSI Manual of Practice Including Master Format
- CSI Uniform Drawing Standard
- CSI Standard Abbreviations
- CSI Standard Reference Symbols
- ASHRAE Handbook for Mechanical Issues
- LEED for Schools for New Construction and Major Renovations

C. ACCOUNTING PROCEDURES

1. MULTIPLE PROJECTS: When working on more than one project for the School District, consultants are required to invoice each project separately using the purchase order (PO) number assigned by the School District.

2. SUPPLEMENTAL FEES: The School District understands that the scope of work for projects may and usually will change during the scope of the project. Consultants are requested to advise the School District, in writing, of changes in scope of work and provide an estimated cost for the fee adjustment prior

to incurring such costs. Consultants are asked to submit this fee adjustment information prior to proceeding with the additional work.

3. PROGRESS PAYMENTS: Cherry Creek Schools will provide payment based on services rendered on a monthly basis. Usually progress payments are authorized/approved within 30 days of receipt of invoice from the consultant.

D. RESPONSIBILITIES/INFORMATION PROVIDED BY CHERRY CREEK SCHOOLS

1. SITE SURVEY: Cherry Creek Schools will furnish an up-to-date survey for the site. The survey will include information required by the consultant to accomplish the work. This information may include existing improvements, topography, utilities, underground and overhead utilities, easements, landscaping, etc. Prior to obtaining the site survey, the consultant will be required to submit to the School District a list of any special survey requirements required for the specific project. The consultant may use AIA Document G501, Request for Proposal - Land Survey, 1994 Edition. A copy of this document is included in Appendix A3.

2. GEOTECHNICAL INVESTIGATION: For new building projects and additions to existing facilities, Cherry Creek Schools will furnish the services of a geotechnical engineer to provide the testing and recommendations required. The design consultant will assist the School District by providing preliminary drawings indicating building placement, floor elevations, and paving locations for parking lots/drives to the geotechnical engineer. The geotechnical engineer will use this information to prepare the foundation/slab/paving recommendations to be contained in the geotechnical report for the project.

   The School District requires that, prior to construction, the specifications prepared by the design consultant be reviewed by the geotechnical engineer to verify that all recommendations and requirements contained in the geotechnical report have been properly interpreted and adequately covered by the construction specifications prepared by the design consultant.

3 TESTING AGENCY: Cherry Creek Schools will employ the services of a testing agency to perform required tests and inspections during the construction phase. The following tests are typically provided by this testing agency:

   a) Soils
   b) Concrete
   c) Masonry grout/masonry reinforcing
   d) Structural steel/welding
   e) Asphalt paving
   f) Other testing as required

4. RECORD DOCUMENTS - EXISTING CONDITIONS: Cherry Creek Schools will furnish one set of prints or photo copies of all available information (reports and drawings) of existing buildings including, where available, civil, landscape, architectural, structural, plumbing, mechanical, electrical drawings, and specifications. The School District will also make available information from AHERA reports indicating the known presence of materials containing asbestos in existing buildings. The School District will reproduce copies of any available ADA (Americans with Disabilities Act) studies and/or recommendations that have been previously prepared. In many cases, the existing drawings and specifications are not "as built" and, as such, the School District cannot guarantee the accuracy of these documents.

5. ASSISTANCE BY REPRESENTATIVES OF CHERRY CREEK SCHOOLS: Representatives of the

School District will join with the consultant in attending meetings/conferences with regulatory agencies to obtain required information, as well as to assist in filing applications that may be required for building permits, location and extent site review submittals and other permits/variances. Representatives of the School District will also assist the consultant by furnishing additional technical, educational, and construction criteria for special issues which may arise during the design and construction phases.

E. ARCHITECT/CONSULTANT RESPONSIBILITIES- SPECIAL ISSUES

1. REMODELING/RETRO-FIT PROJECTS: The consultant shall be required to field verify information provided by the School District that relates to areas being remodeled. The consultant shall also field verify critical conditions and dimensions required to interface new construction with existing conditions. On the construction documents, the Design Consultant shall clearly distinguish between existing, salvaged, relocated, demolished, removed, and new construction; and shall clearly define the disposition, delivery, and storage of salvaged items.

2. DESIGN/COORDINATION COMMITTEES: Working with the Design Consultant, in an open collaborative process, will be a Design/Coordination Committee composed of technical and nontechnical School District staff, students, parents, citizens, and other involved stakeholder groups. They will assist the Consultant in analyzing specific needs for the project and will review recommendations/design options prepared by the Design Consultant. The committee's primary involvement will be during the programming (educational specifications), schematic design, and design development phases of the project.

3. SITE PLAN REVIEW BY PUBLIC AGENCIES: The Design Consultant, working together with representatives of the School District will be responsible for preparing site planned submittals (Location and Extent) required by the City where the project is located (Aurora, Centennial, or Greenwood Village) or Arapahoe County if not located within a city. As an example, the process and submittal requirements for the City of Aurora and Arapahoe County are included in Appendix A4 of this document.

   The Design Consultant will also prepare, coordinate, and review drainage study and erosion control documents required by the appropriate jurisdictions and submit and obtain approval of any required civil construction documents required for public improvements including, but not limited to, utilities, public streets/sidewalks, drainage/water quality structures, etc.

4. BUILDING CODE REVIEWS/BUILDING PERMIT: The Design Consultant will be responsible for meeting with appropriate building officials to review code issues and make submittals required to obtain a building permit for the project. Projects located in Arapahoe County, Greenwood Village or Centennial will be reviewed by the Colorado Department of Labor and Employment, Division of Oil and Public Safety and permits for general construction, mechanical, plumbing, and electrical will be obtained from the State: (see website for specific requirements). For projects located in the City of Aurora, the School District will decide, on a project by project basis, if the review/permit will be through the State or with the Aurora Building Division. Should the District decide to submit the project to the Aurora Building Division, the plumbing and electrical reviews and permits will still fall under the jurisdiction of the State (Electrical and Plumbing Divisions).

5. FIRE DEPARTMENT REVIEW AND PERMIT: Projects located in Arapahoe County, Greenwood Village or Centennial will be reviewed by either the South Metro Fire Rescue Authority, Cunningham Fire Protection District or Denver Fire Department, depending on the location of the project. Projects located in the City of Aurora will be reviewed by the Aurora Life Safety Division through the Building Department. The Design Consultant shall meet with and submit documents required by the appropriate fire districts

and also submit these same documents to the State Division of Fire Safety.

6. HEALTH DEPARTMENT REVIEW: Educational facilities are required to be designed to meet the criteria set forth in the "Rules and Regulations Governing Schools in the State of Colorado", administrated by the Colorado Department of Public Health and Environment. The Design Consultant shall coordinate all submittals required by this State Agency. Usually, this agency delegates its authority to review schools to the Tri-County Health Department.

7. BUDGETARY REQUIREMENTS: The Design Consultant shall make every effort to design the project within the budgetary requirements set by Cherry Creek Schools. The budget will be set by the School District prior to the commencement of design services and will be reviewed at each subsequent phase prior to construction. If the low bid exceed the budget established by the School District, the Architect will work with the School District to bring the project into budget.

8. BIDDING PHASE: The construction of new and renovated projects by the School District is generally accomplished by a conventional bid procurement process whereby the School District prequalifies all general contractors and, for larger projects, major subcontractors. The Design Consultant shall be responsible for coordinating this prequalification process and will assist the Owner in obtaining and reviewing the submittals from prospective contractors/subcontractors. Typically the School District uses AIA Document A305 as the required submittal document from the prospective contractors/subcontractors. Occasionally, the School District will select a construction manager/general contractor for the project. When this delivery process is used, the Design Consultant will generally be included in the selection process.

F. FORMATS FOR DELIVERABLES FROM CONSULTANTS:

1. ELECTRONIC MEDIA (GRAPHIC/NON-GRAPHIC): The School District requires all plans (site, floor, ceiling, roof, HVAC, plumbing, electrical technology, etc.) be prepared in CAD electronic media. The program for preparation of these plans shall be AutoCAD, and the information shall be submitted in DVD format. The version of AutoCAD to be submitted shall be verified with the School District.

2. HARD COPY MEDIA: All presentation boards shall be maximum size 30" x 42". All reports (educational specification, planning studies, schematic designs/design development reports, project manual, etc.) shall be in 8 ½" by 11" format unless otherwise authorized by the School District. All original construction document paper prints (updated with as-built information) shall be in 24" x 36" or 30" x 42" format.

3. PROJECT DEVELOPMENT AND CONSTRUCTION SCHEDULES: Project development schedules prepared by the Design Consultant shall show sufficient detail that all phases of the project from predesign through close-out are indicated and the information shall be provided in either 8 ½ "x 11" or 11" x 17" format. Schedules are to be updated at the completion of each phase of the project.

4. CONSTRUCTION COST ESTIMATES: The construction cost estimates prepared by the Consultant shall reflect "all" costs related to the project including, but not limited to, the following:

    a) Site Acquisition
    b) On-site construction
    c) Off-site construction
    d) Professional services/fees
    e) Furniture and equipment
    f) Technology
    g) Utility connections and development fees

h) Miscellaneous Owner's costs
i) Bid reserve
i) Construction reserve
k) Any proposed construction alternates

Costs relating to site acquisition, furniture and equipment, technology, miscellaneous Owner's costs, and the reserve costs will be furnished by the School District for inclusion in the estimate by the Design Consultant.

5. BUILDING CODE ANALYSIS: The design consultant shall prepare a building code analysis at the schematic design phase of the project and shall document that analysis in written format. The code analysis shall be updated at the design development and construction document phases and a summary of the code analysis shall be included on the first sheet of the construction documents. This code analysis is in addition to any submittal information required by the State Division of Oil and Public Safety. The building code analysis shall include, but not be limited to, the following:

   a) Fire zones
   b) Occupancy groups
   c) Description of existing and proposed construction types/systems
   d) Fire protection
   e) Occupancy/area separations/fire walls
   f) Allowable floor areas
   g) Allowable area increases
   h) Actual/proposed gross area tabulations
   i) Height, number of stories
   j) Exiting
   k) Fire extinguishing systems
   l) Roof design, fire retardancy, and drainage
   m) Mechanical systems
   n) Plumbing fixture counts
   o) Electrical systems
   p) Energy code compliance calculations

6. BID TABULATION: The design consultant shall prepare, print, and distribute at the bid opening a bit tab spreadsheet matrix with the following labels:

   a) Bidders names
   b) Bid signed and sealed
   c) Bid security
   d) Acknowledgment of each addendum
   e) Completion date
   f) Base bid
   g) Each bid alternate
   h) Unit prices
   i) Names of major subcontractors (Verify subcontractors to be included on the bid form with the School District.)
   j) Acceptance of assignment of items pre-ordered by the School District, if required.

7. CONFERENCE RECORDS: The design consultant shall be responsible for the preparation, printing, and distribution of conference records summarizing the discussion/action at all committee and coordination meetings. The format shall include, but not be limited to, the following:

a) Project title
b) Project meeting date/time
c) Project meeting location
d) Attendees
e) Purpose of meeting
f) Items discussed, decisions made, assignment of responsibility for resolution of issues
g) Attachments (handouts used during the meeting)
h) Distribution list

8. PROJECT MEETING MINUTES/FIELD REPORTS: The design consultant shall be responsible for preparing project meeting minutes/field reports during the construction phase. Typically these reports are prepared on a weekly basis during construction. The format shall include but not be limited to the following topics:

a) Project title
b) Project meeting date/time
c) Project meeting location
d) Attendees
e) Review/approval of minutes of previous meeting
f) Review of work since previous meeting
g) Field observations, problems, conflicts
h) Status of previous instructions issued
i) Problems which impede construction schedule
j) Review of off-site fabrication and material delivery schedules
k) Review status of contractor's construction schedule
l) Discuss procedures to regain projected schedule
m) Itemize work for succeeding work period
n) Coordination of schedules
o) Maintenance of quality standards
p) Review contractor's submittals
q) Review proposed changes for effect on other trades, construction schedule, completion date, and costs
r) Coordination of Owner's separate contracts
s) Project conditions (weather and personnel/subcontractors on site)
t) Work in progress during visit and instructions issued
u) Other business as required

G. SPECIALTY CONSULTANT SERVICES:

For certain projects, the School District may employ specialty consultants. These consultants and the services they provide include, but are not limited to, site surveys, geotechnical reports/analysis, site master planning services, asbestos abatement services, and technology services. A summary of the scope of services generally required for these specialty consultants is listed below:

1. SITE SURVEY: Scope of services shall be per AIA Document G601, Request for Proposal - Land Survey, 1994 edition.

2. GEOTECHNICAL ENGINEERING SERVICES: The scope of services shall be per AIA Document G602, Request for Proposal - Geotechnical Services, 1993 edition.

3. SITE MASTER PLANNING SERVICES: The scope of services shall generally be as follows:

a) Review background information provided by the School District including site survey, geotechnical reports, archive drawings, and preliminary project scope statements.
b) Tour the proposed sites with representatives of the School District and other stakeholders.
c) Revisit the sites as required.
d) Photograph key features of the site and related environment.
e) Prepared specialized studies as defined by the School District (traffic, drainage, legal, etc.).
f) Document conditions of existing site elements.
g) Attend "brainstorming" sessions with School District representatives to review requirements, possibilities, proposed alternatives, advantages, disadvantages, costs, schedules, etc.
h) Develop no fewer than two site development master plan concepts and review those concepts with representatives of the Owner.
i) Prepare final recommended master plan.
j) Prepare written and graphic report summarizing the process, data, and recommendations and provide presentation board(s) illustrating the approved site master plan.

4. ASBESTOS ABATEMENT SERVICES: The scope of services shall generally include the following:

a) Review background information from the School District including archived drawings, AHERA management plan, preliminary project scope statement, schematic design documents from separate design consultant, design development documents from separate design consultant, and construction documents from separate design consultant.
b) Attend meetings with School District staff.
c) Conduct on-site physical inspections of the existing facilities to survey asbestos-containing materials in the building and obtain sampling as required and approved by the School District.
d) Prepare a written and graphic report quantifying all asbestos-containing material impacted by proposed renovation. The report shall include a summary of alternative solutions with pros and cons noted, plan graphics, recommendations regarding priorities, alternatives, costs, scheduling, and feasibility. The report shall include the discussion of any unresolved issues present at the time of the preparation of the report.
e) Prepare contract documents (plans and specifications).
f) Administer the bidding phase and awarding of contract to successful bidder.
g) Construction contract administration including close-out. This construction phase shall include the following services:

- Preparation of daily logs and checklist
- Visual observation reports before, during, and after construction
- Air-monitoring reports before, during, and after construction
- Close-out report

H. TECHNOLOGY SERVICES:

Technology services shall generally include the design of voice, video, security, and data wiring and equipment required for new and renovated facilities. The technology consultant will typically work as a subconsultant to the Architect in the design of new facilities; however, this consultant may also work directly for the School District on small projects. The scope of services to be performed generally includes the following:

1. Review of background information from the School District including the following:
   - Preliminary project scope statements.
   - Archived drawings of existing facilities.
   - Design development documents from separate design consultant for renovations or new facilities.

- Construction documents from separate design consultant for renovations or new facilities.

2. On-site physical inspection of the existing facilities to document the condition of existing technology components.

3. Meetings with School District technology staff to define short and long term voice, data, video, and security requirements including identification of areas of special concern.

4. Preparation of written and graphic report including summary of alternative solutions (with pros and cons), recommendations regarding priorities, alternatives, costs, scheduling, and feasibility. Also included in the report will be a listing of any unresolved issues.

5. Preparation of contract documents (plans and specifications) including coordination with architect and electrical consultant using electronic format (AutoCAD) for technology plans.

6. Prequalifications of potential contractors including the issuance of request for qualifications to prospective contractors and evaluation of those responses.

7. Administration of the bid phase including review/recommendations on award of bid.

8. Construction contracted administration phase including visual/written observation reports during construction, verification of payment requests, final observation/punchlist and close-out.

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

00 00 01 – PROJECT MANUAL COVER PAGE

A. Format: No specific format so long as the following information is included:
   1. The words "PROJECT MANUAL" as the title.
   2. Official project name/title (the name of the facility or site).
   3. School District Name: CHERRY CREEK SCHOOL DISTRICT N0. 5, ENGLEWOOD COLORADO.
   4. Date.
   5. Design Consultant firm name, address, phone number, and email address.

00 00 02 – PROJECT DIRECTORY

A. Format: No specific requirements so long as the names, addresses, telephone numbers, and email addresses of all consultants and subconsultants are listed.

00 00 03 – SEALS PAGES

A. Format: No specific format. Include language similar to the following:

"I hereby certify that the portion of this technical submission as described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered (Architect / Professional Engineer / Landscape Architect) under the laws of the State of Colorado."

00 00 03 – TABLE OF CONTENTS

A. Format: No specific requirements so long as all documents, divisions, and section names/ numbers are listed.

00 11 13 – ADVERTISEMENT FOR BIDS

A. Format: Cherry Creek School District Standard. See sample attached in Appendix B3.

B. Verify with the School District the following data:
   1. Bid time and date for base bid and alternates.

00 21 13 – INSTRUCTIONS TO BIDDERS

A. Format: Cherry Creek School District Standard.

B. Verify with the School District the following information/data:
   1. Prequalification criteria for general contractors and major subcontractors.
   2. List of prequalified general contractors.
   3. List of prequalified subcontractors.
   4. Subcontractors required to furnish a 100% Performance and Payment Bond to the successful general contractor.
   5. Location, date, time and attendees of mandatory pre-bid conference.
   6. Desired completion date for the project and amount of liquidated damages for failure to complete the project on time.

00 31 21 – INFORMATION AVAILABLE TO BIDDERS

A. Format: No specific format as long as the following information is included:
   1. Project name, consultant name, date, and project number as it appears on the geotechnical study/report for this project.
   2. Project name, consultant name, date, and project number as it appears on the site survey for this project.
   3. Project name, consultant name, date, and project number as it appears on any addendums to the site survey or geotechnical study/report for this project.
   4. Name and date of any previous bid packages or other construction documents that relate to this project.

00 41 13 – GENERAL CONTRACT BID FORM/ALTERNATES/UNIT PRICES

A. Format: Cherry Creek School District Standard.

B. Verify with the School District the following information/data:
   1. The suppliers with whom the School District has issued purchase orders for materials and/or equipment that will be assigned to the successful general contractor and the amount of each purchase order.
   2. The major subcontractors whose names will be required on the completed bid form.
   3. The required completion date and amount or liquidated damages.
   4. Description and listing of each alternate.
   5. Description and listing of each unit price.

00 43 13- BID BOND

A. Format: Cherry Creek School District Standard.

00 52 13 – AGREEMENT FORM

A. Format: Cherry Creek School District Standard "Standard Form of Agreement between Owner and Contractor", AIA Document A101-2017, as issued by the American Institute of Architects.
   1. Verify current version of contract with School District.

B. Verify with the School District:
   1. Pre-order of material and/or equipment.

00 54 13 – ASSIGNMENT OF SUPPLIER'S CONTRACTS

A. Format/Language: Cherry Creek School District Standard.

B. Verify with School District:
   1. Materials and/or equipment to be pre-purchased and the contract assigned to the General Contractor.
   2. Inclusion of the suppliers' proposals in the project manual or addition by addendum.

00 61 13 – PERFORMANCE BOND AND PAYMENT BOND

A. Format/Language: Cherry Creek School District Standard; "Performance Bond and Payment Bond", AIA Document A312-2010, as published by the American Institute of Architects.

00 72 13 – GENERAL CONDITIONS

A. Format/Language: Cherry Creek School District Standard; "General Conditions of the Contract for Construction", AIA Document A201-2017, as published by the American Institute of Architects.
   1. Verify current version of contract with School District.

00 73 00 – SUPPLEMENTARY CONDITIONS

A. Format/Language: Cherry Creek School District Standard - Modified as approved by the School District.

B. Verify with School District:
   1. Building permit issued by the Colorado Division of Fire Prevention and Control or the City of Aurora.
   2. Wording for extensions of time - the typical conditions for extension of time are included in the sample supplementary conditions. For projects with extremely tight time schedules, the following statement shall modify the General Conditions:

      "Extensions of time for weather delays, minor changes in the work, and labor disputes will not be included in this project."

   3. The amount of comprehensive general and automobile liability to be included as modifications to Article 11. Also verify the deductible amount the contractor shall pay when making a claim against the Owner's Builder's Risk Property Insurance Policy.

END OF SECTION

DIVISION 01 – GENERAL REQUIREMENTS

01 11 00 – SUMMARY OF WORK

PART 1 - GENERAL

A. Format: No specific requirements, as long as the following information is included after verification with the School District:

1. Examination of the site by the Contractor with wording similar to:

   a. *Failure to visit site will in no way relieve any Contractor from necessity of furnishing materials or performing work that may be required to complete work in accordance with Drawings and Specifications without additional cost to Owner.*

   b. *The locations of all existing utilities, as indicated on the Site Survey and on the various Site Plan Drawings, are approximate. General Contractor shall be responsible for verifying location of all underground and above ground utilities indicated on the Site Survey or on the Civil, Architectural, Mechanical, and Electrical Site Plans prior to construction. Any damage to these utilities shall be the Contractor's responsibility and they shall be repaired at no cost to the Owner.*

2. Definition of other bid packages/separate contracts such as site grading, utilities, etc.
3. Work to be accomplished by others that will affect the work included in this project. This typically refers to site grading performed by a separate contractor. The wording might be similar to:

   a. *Site Grading: Rough site grading will be accomplished by the "Bid Package A" Contractor prior to general contractor move-in. All fill placement will be controlled and tested by the geotechnical engineer.*

   b. *Site Certification: Following completion of the site grading, the Bid Package A Contractor will be required to certify the final grades prior to acceptance by the Owner.*

   c. *Site Survey: Following completion of the "Bid Package A" Site Grading, the Owner will obtain a final topographical survey which will be made available to bidders by Addendum.*

   d. *Acceptance of Site: Prior to move-in, the General Contractor will be required to compare the grades indicated on the Site Development Plan with on-site grades established by the "Bid Package A" Site Grading Contractor and accept the site in writing "as-is" or notify the Owner in writing of any discrepancies that do exist. No extras will be allowed for discrepancies between drawings and actual on-site conditions after such acceptance. Commencement of on-site construction by the Contractor prior to Receipt of Letter of Acceptance by the Owner shall also constitute acceptance of on-site conditions by the General Contractor.*

4. Listing and brief definition of separate contracts between the Owner and other contractors that might include, but not be limited to, testing of radio signal strength for public safety radio systems; on-site gas lines; power service to the site; telephone service to the site; off-site streets, utilities, sidewalks; technology wiring/equipment; mechanical systems testing, adjusting, and balancing. The wording/brief description of these separate contracts might be as follows:

   a. *Testing, Adjusting and Balancing: The hydronic and air distribution testing and balancing shall be done by an independent consultant separately contracted by the Owner.*
   b. *The Mechanical Subcontractor under this Contract shall coordinate with the owner's separate Test and Balance Consultant to verify that all items such as: the thermometer wells, pressure test cocks, access doors, etc., are furnished and installed as required to allow tests and adjustments to be performed by the separate Test and Balance Consultant.*
   c. *The Mechanical Subcontractor shall coordinate with the Owner's separate Testing and Balance Consultant as required to ensure that the testing and balancing of the mechanical system will be completed prior to the listed date of substantial completion.*

5. Work sequence if the project has phased completion dates. An example might be as follows:

   a. *PHASE 1 – Early Completion Site Elements: This first phase shall include, but not be limited to the following construction activities that shall be completed on or before (date).*
      1) *Installation of water meter, supply lines and backflow preventer for irrigation system, irrigation lines serving the fields, irrigation controller, field building and temporary power to irrigation controller in the field building.*
      2) *Running track with drainage system, asphalt pads, runways, tennis courts, chain link fencing, backstops, and other athletic field amenities indicated on the Drawings.*
      3) *Soil preparation, fine grading, seeding of playfields, native grass seeding of disturbed areas, and other landscaping as included on the drawings.*
      4) *This completed work will be turned over to the School District for their maintenance and this early completion area will not be used for athletic or P.E. activities until (date).*

   b. *PHASE 2 – All Remaining Sitework and Buildings: All remaining sitework including the balance of landscape work shall be completed on or before (date). The High School Building shall also be completed on or before (date).*

6. Contractor's use of the Owner's site/premises including a definition of the limits where the contractor will be working, the related staging areas, and restrictions regarding construction access to the site. An example might be as follows:

   a. *Limitations: Operations of the General Contractor shall be limited to areas where work is indicated on the drawings.*
   b. *All construction traffic access to building site shall be limited to Street X only. No construction traffic is permitted on Street Y. Parking of construction vehicles shall be on site only.*
   c. *The asphaltic base course for access drive and parking lot on the south side of the building shall be completed as soon as possible to permit their use as staging areas for building construction and to provide the access required by the Fire Department. Prior to completion of the project and as directed by the Architect, the Asphalt Paving Subcontractor shall return to the site at which time he shall clean the base course, apply a tack coat and complete installation of the asphaltic concrete surface course.*

7. Pre-ordered products and/or shop drawings - an example might be as follows:

   a. *In order to conserve construction time, the Owner has pre-ordered and paid for shop drawings for steel joists and steel deck from an independent shop drawing service. These shop drawings will be completed and reviewed by the Structural Engineer prior to date of Notice of Award.*
   b. *Following Notice of Award, shop drawings for steel joists and steel deck will be turned over to the General Contractor for use by his subconsultants.*

B. Protection of Concrete Slabs to be Stained and Polished: *(NOTE: Include this Article in the "Summary of Work" section in projects where Section 03 35 43 "Polished Concrete Finishing" is used as all trades are responsible for helping to protect the concrete slabs to be polished).*

1. Contractor and all sub-contractors shall take precautions to prevent damage and soiling of concrete slabs scheduled to be polished as final finish.
   a. The following substances can penetrate the surface and stain the slab: Red chalk, permanent markers, wax pencils, adhesives, oils, gas, primer, paint, stain, poly seal, caulk, PVC primer/cleaner, PVC adhesive, food, grease, beverages and rust from metal or nails.
   b. Lumber, wood boards, sawdust plywood, thermo-ply, pressboard, insulation board and plastic all draw moisture from the slab. If left, they can transfer resins, tannins and water stains to the slab.

2. Precautions shall include but not be limited to:
   a. Prevent damage to floor slabs from substances listed in above paragraphs.
   b. Prohibit parking or driving of vehicles on concrete slab until protective cover is installed.
      1) If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid, or other liquids.
   c. Prohibit temporary placement and storage of steel members on concrete slab.

d. Install protective covering of heavy cardboard, rosin paper, hardboard, plywood, Masonite, or other protective sheeting over entire floor surface.
   1) 6 mil black plastic is acceptable, overlapping by one foot, and taped at the seams. Do not tape to the floor.

e. Prohibit pipe cutting and using pipe cutting machinery on concrete slabs.
f. Do not write on the slab with anything except light pencil.
g. Do not allow use of red chalk for lay-out lines.
h. Do not allow use of unprotected floors for lay down, staging, or use by any trades.
i. Floors must be completely protected during application of primer, paint, stain, or lacquer. Painters may use Green Tape, 24-hour tape, craft paper, or drop cloths to protect floor and the field. Only Green Tape or lacquer-free tape is acceptable for the protection of acid-stained floors. Do not leave tape down for longer than 72 hours as it can leave a residue or pull off sealed surfaces.
j. Keep area clean.

3. Coordinate requirements for concrete slab protection with polished concrete subcontractor to assure compliance with requirements.

01 22 00 – UNIT PRICES

PART 1 - GENERAL

A. Summary: This Section includes listing of items and related sections for which unit prices will be taken. Typical unit price items may include, but not be limited to:
   1. Drilled Piers:
      a. Provide unit price for OVERRUN and UNDERRUN of each size drilled pier.

   2. Landscape Materials.
   3. Earthwork / Structural Fill.

B. Restrictions/Critical Criteria: All unit prices shall include labor, materials, equipment, services, delivery to the project, overhead, profit, insurance and other incidental expenses to complete the work specified. Work covered by unit prices shall be performed in accordance with requirements of the applicable sections of the Specifications.

01 23 00 – ALTERNATES

PART 1 - GENERAL

A. Summary: This Section shall include a listing of items and related sections for which alternate prices will be taken.
   1. Each Alternate shall include a clear description of the scope of work that is "Base Bid" and a description of the work that is to constitute the "Bid Alternate".

B. Definitions/Restrictions/Critical Criteria:
   1. Definitions and Explanations: "Alternates" are defined as alternate products, materials, equipment, systems, methods, units of work, or major elements of the construction, which may, at the Owner's option be selected for the work in lieu of the corresponding requirements of the Contract Documents. Selection may occur prior to the Contract Date, or may be deferred for possible selection at a subsequent date. Alternates may or may not change the scope and general character of the work substantially.
   2. Notification: Immediately following the award of the Contract, the Contractor shall prepare and distribute to each entity or person to be involved in the performance of the Work, a notification of the status of each alternate scheduled and including those subsequently added by notification during bidding. Indicate which alternates have been: 1) accepted, 2) rejected, and 3) deferred for consideration at a later date as indicated. Include full description of negotiated modifications to alternates, if any.

01 31 00 – MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

A. Summary: This Section includes a listing of mechanical and electrical equipment and defines responsibilities of the mechanical (MC), and electrical (EC), and controls (TC) contractors for furnishing, setting, providing power wiring, and providing control wiring for this equipment. An example for a typical school would be as follows:

ITEM	FURNISHED BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment Motors	MC	MC	EC	--
Motor Starters & Overload Heaters	MC	EC	EC	MC
Fused & Unfused disconnections, Switches, Thermal Overload, and Heaters	EC	EC	EC	--
Manual Operating & Speed Switches (Carrying load Currents)	MC	EC	EC	EC
Control Relays & Transformers	TC	TC	EC	TC
Interface of Mechanical Systems & Devices with Fire Alarm System	EC	EC	EC	EC
Thermostats (Line Voltage)	TC	TC	EC	TC
Temperature Control Panels	TC	TC	EC	TC
Fire & Smoke Detectors, including Relays for Fan Shutdown & Smoke Damper Closure	EC	EC	EC	EC
Smoke Dampers & Combination Fire/Smoke Dampers	MC	MC	EC	EC
Motor & Solenoid Calves, Damper Motors, Control Valves, Fan Interlocking Wiring, Low-voltage Thermostats	TC	TC	TC	TC
Freezestats, Aquastats TC Flow Switches	TC	MC		TC

ITEM	FURNISHED BY	SET BY	POWER WIRING	CONTROL WIRING
Pushbutton Stations & Pilot Lights (Manually Operated Switches not carrying Load Current)	EC	EC		TC
Boiler and Water Heater Controls including F.I.A. Gas Train	MC	MC	EC	TC
Temporary Heating Connections	MC	MC	EC	TC
Heat Tape	EC	EC	EC	EC
Variable Frequency Drives	MC	EC	EC	TC

B. Restrictions/Critical Criteria:

1. All motor starters shall be furnished by MC and shall be complete with three O.L. heaters and shall conform to NEC and NEMA requirements.
2. Control relays and control transformers shall be furnished by TC except where furnishing such items is specifically required by electrical specifications and/or drawings.
3. Pushbutton stations carrying full load current are to be wired by EC.
4. Exhaust Fans: The Electrical Contractor will furnish and install circuits, feeders and disconnect switches, and make all connections to motors and controls. Where exhaust fans are switched with lights, a two-pole toggle switch will be provided by the EC. Where exhaust fans are controlled by sixty (60) minute timer switches, electrical contractor shall provide and install the switch(es). Where exhaust fans are interlocked with other mechanical equipment, the interlock wiring will be furnished by the TC.
5. If disconnect switches are furnished as part of factory wired equipment, wiring and connections only by EC.
6. If float switches, line thermostats, time switches, etc., carry the FULL LOAD CURRENT to any motor, or heating element or other similar item, they shall be furnished by TC.

   They shall be set in place and connected by the EC, except that where such items are in integral part of the mechanical equipment or directly attached to ducts, piping, etc.; they shall be set in place under the MC and connected by the EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place, and wired by TC.

7. Wiring from alarm contracts to alarm system shall be by EC, all control function wiring by TC. Smoke dampers and combination fire smoke damper actuators shall be 11O Volt.
8. Fire and smoke detectors in ductwork on mechanical equipment are mounted by MC. All others are mounted by EC. Locations to be determined by EC (Fire Alarm Sub).
9. EC shall coordinate quantity and location of mechanical control panels with mechanical plans and specifications and with MC. Provide a 120 Volt, 1-pahse dedicated circuit from each control panel on group of control cabinets to the nearest panelboard of correct voltage characteristics.
10. It shall be the responsibility of the Mechanical Contractor (MC) to transmit to the General Contractor, all changes of electrical characteristics which result from substitution of equipment. Any and all charges for such changes shall be the responsibility of the Mechanical Contractor.

11. MC shall not fabricate ductwork until he has inspected the space in which the ductwork will be installed, coordinated the location of ductwork with the light fixtures to be installed by EC and assured that all ductwork will fit the space provided. EC shall transmit final approved shop drawings and product data showing sizes, heights, and locations of light fixtures to the General Contractor and MC to allow the coordination to take place. MC and EC shall coordinate the layout and installation of mechanical and electrical equipment in Mechanical and Electrical Rooms.

01 31 19 – PROJECT MEETINGS AND COORDINATION

PART 1 - GENERAL

A. Summary: This Section defines the various types of required project meetings.

B. Restrictions/Criteria:
   1. Preconstruction Meetings:
      a. A meeting will be scheduled by the Architect within ten (10) days following Notice of Award, at which time the Contractor, will submit executed bonds and insurance certificates. Administrative requirements including but not limited to, subcontractor lists, schedule of values, payment applications, change order procedures, sales tax records and project closeout will be reviewed in detail.
      b. Site Mobilization Conference: A meeting will be scheduled by the Architect at the site immediately prior to Contractor move-in. Representatives of the Contractor, Geotechnical Engineer, Owner, and Architect will be present. Job site procedures, to include the following items, will be discussed:
         1) Procedures for maintaining record documents
         2) Owner's requirements
         3) Construction facilities and controls
         4) Temporary utilities
         5) Security and housekeeping procedures
         6) Materials testing
         7) Services of Geotechnical Engineer
         8) Building layout
         9) Use of Architect's Consultants

   2. Weekly Progress Meetings:
      a. Regular weekly meetings lasting approximately one hour shall be scheduled at Cherry Creek Educational Services Center. The Contractor's Project Manager and Superintendent, Owner and Architect will be present. Minutes of progress meetings shall be kept and distributed by the Architect. The following items will be discussed:
         1) Review and Approval of Previous Meeting Minutes.
         2) Review of Work Progress Since Previous Meeting.
         3) Review of Problems/Conflicts.
         4) Status of Previous Instructions Issued.
         5) Review of Off-site Fabrication and Delivery Schedules.

6) Problems Which Impede Construction Schedule.
7) Review Status of Contractor's Construction Schedule.
8) Discuss Procedures to Regain Projected Schedule.
9) Itemize Work for Succeeding Work Period Up to Next Progress Meeting.
10) Coordination of Schedules.
11) Maintenance of Quality Standards.
12) Review Contractor's Submittals.
13) Review Proposed Changes for Effect on Other Trades, Construction Schedule, Completion Date and Costs.
14) Coordination of Owner's Separate Contracts.
15) Work in Progress During Visit.
16) Other Business as Required.

01 33 00 – SUBMITTALS

PART 1 - GENERAL

A. Summary: This Section includes submittal requirements/process for general information submittals and for shop drawings, product data and samples.

B. Submittals Required:
1. "Administrative Submittals" are submittals relating to provisions of the Contract Documents, and include but are not limited to:
a. Insurance certificates.
b. Performance and payment bonds.
c. List of subcontractors/material suppliers.
d. Construction schedule and updates.
e. Quality control plan.
f. Schedule of values.
g. Submittal schedule.
h. Applications for payment.
i. Substitution requests.
j. Close out documents.

2. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals" and include, but are not limited to:
a. Shop drawings.
b. Product data.
c. Samples.

3. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Restrictions/Critical Criteria:

1. General: In conjunction with the first progress schedule, the contractor shall submit to the Architect a shop drawing submittal schedule outlining dates for submittal of all shop drawings and product data.
   a. Submittals shall be made early enough to allow a fifteen (15) day time period from the received date for review by the Architect. Shop drawing submittals will note verified field-measured dimensions, as-built conditions, or special coordination conditions with other contractors. All on-site measurements shall be made before shop drawings are reviewed by the Architect.
   b. Shop drawings shall not be reproductions of contract documents, they shall be original drawings prepared by the supplier or subcontractor. Drawings information shall be prepared specifically for this project and drawn to accurate scale. Deviations from the contract documents shall be clearly identified and shall reference applicable construction drawings or specification sections.
   c. Product data for each element of construction or system shall be a single submittal and shall include printed information such as manufacturer's installation instructions, catalog cuts, rough-in data, wiring diagrams and performance information. Shop drawings and product data submittals shall be reviewed and approved by the contractor for completeness, accuracy, and conformity with the contract documents. Notes and corrections shall be made on all copies of submittals, signed by the individual reviewing the documents, and stamped with the contractor's date/review stamp. Every sheet of shop drawings shall be stamped and signed by the contractor.
   d. Shop drawings and product data not stamped and signed by the contractor will be rejected and returned by the Architect.

2. Shop Drawings: Each submittal or resubmittal shall consist of a minimum of one correctable reproducible translucent and three prints.
3. Product Data: Each submittal or resubmittal shall consist of a minimum of six copies of brochure material and related samples. Each copy shall clearly show applicable choices and options.
4. Job site documents: Only approved shop drawings or product data shall be kept at the job site. The Contractor shall keep a complete set of such documents on file at the job site.
5. Color selection samples: The Contractor will provide a checklist indicating materials where color, texture or finish is subject to selection by the Architect and as defined in the various specification sections. Certain other samples may also be requested for use by the Architect in preparation of color and material sample presentations for the Owner.
   a. With the checklist, the Contractor shall promptly (30 +/- days after award) assemble and deliver to the Architect two (2) complete collections of all required samples. Upon receipt of a complete collection of samples the Architect will, with reasonable promptness, make the selections and prepare and deliver to the Contractor a schedule covering all items subject to selection. The Architect reserves the right not to make individual determination or selections until all samples of materials are furnished to him.

6. Contractor shall maintain and accurately update a submittal log showing the current status of the submittals. The updated log shall be reviewed with the architect and owner at the project meetings.

01 35 00 – REGULATORY REQUIREMENTS

PART 1 - GENERAL

A. Summary: This Section includes listing of approval and recommendation agencies - Verify reviewing agency and current codes (Colorado Division of Oil and Public Safety or City of Aurora Building Department).

B. Referenced Standards/Minimum Criteria:

Colorado Division of Labor	or	City or Aurora
International Building Code, 2015 Edition		International Building Code, 2015 Edition
International Fire Code, 2015 Edition		International Fire Code, 2015 Edition
International Plumbing Code, 2015 Edition		International Plumbing Code, 2015 Edition
International Mechanical Code, 2015 Edition		International Mechanical Code, 2015 Edition
International Energy Conservation Code 2015 Edition		International Energy Conservation Code 2015 Edition
National Electrical Code (NFPA 70-2020)		National Electrical Code (NFPA 70-2020)
ANSI-A17.1 Safety Code for Elevators & Escalators		ANSI-A17.1 Safety Code for Elevators & Escalators
ANSI-A117.1 Standard for Accessible and Usable Buildings and Facilities (2009)		ANSI-A117.1 Standard for Accessible and Usable Buildings and Facilities (2009)

C. Restrictions/Critical Criteria:

1. Require compliance with all requirements and codes adopted by the Fire Department, Utility Company, and Health Department having jurisdiction. Require compliance with all other requirements of State Division of Oil and Labor, Public Safety Section, and any other local, state or federal requirements which are applicable, particularly any local or state regulations regarding dust control, noise abatement, permissible hours of construction, water management and erosion control.
2. In case of a conflict between referenced applicable codes, or other requirements, the one having the more stringent requirements shall govern. Where governing codes or requirements indicate that the drawings or specifications do not comply with the minimum requirements of the codes or requirements, the Contractor shall be responsible for informing the architect of the condition that may be in violation with the code obtain direction on how to proceed. Drawings and specifications shall be followed where they are superior to code requirements.
3. Protection of life, health and public welfare as it relates to the execution of the construction contract is the responsibility of the Contractor.

4. The Contractor shall have sole responsibility for compliance, on the job site with all applicable portions of the Occupational Safety and Health Act and compliance with the Equal Employment Opportunity Act.

01 42 00 – REFERENCED STANDARDS

PART 1 - GENERAL

A. Summary: This Section includes the definition and application of referenced standards.

B. Restrictions/Critical Criteria:
   1. Where workmanship or products are specified incorporating trade or federal standards or by association, the requirements of the referenced standard shall apply except where more rigid standards are specified or are required by applicable codes.
   2. Where referenced standards are required, a copy of the standard shall be maintained by the contractor at the job site during the work.
   3. The date of the standard is that in effect as of the date on the project manual except when a specific date is specified or when the standard is part of an applicable code which includes an edition date.

01 45 00 – QUALITY CONTROL

PART 1 - GENERAL

A. Summary: This Section includes description of the various tests required to provide appropriate quality control and identifies who pays for the tests.

B. Referenced Standards/Minimum Criteria: Tests shall be made by an accredited testing laboratory. Except as otherwise provided sampling and testing of materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and methods of the American Society of Testing and Materials (ASTM). Where additional or specific information concerning testing methods, sample sizes, etc., is required, requirements are included under the applicable sections of the Specifications.

C. Restrictions/Critical Criteria:
   1. Contractor shall provide equipment and facilities required for conducting field tests and for collecting and forwarding samples. Contractor shall not use any materials or equipment represented by samples until tests, if required, have been made and the materials or equipment are found to be acceptable. Any product deemed unfit for use shall not be incorporated into the work.
   2. All materials or equipment proposed for use may be tested at any time during their preparation or use. Contractor shall furnish the required samples without charge and shall give sufficient notice of the placing of orders to permit the testing. Products may be sampled either prior to shipment or after being received at the site of the work.
   3. Control tests of concrete work shall be made at the Owner's expense at such times and number as directed by the Owner.

4. Control tests of masonry work including masonry reinforcing shall be made at the Owner's expense at such times and number as directed by the Owner.
5. Drilled pier and related concrete operations shall be observed by a Geotechnical Engineer selected and paid by the Owner.
6. Control tests of fill and backfill shall be made at the Owner's expense by the Geotechnical Engineer Laboratory. The Geotechnical Engineer will make sufficient tests at the expense of the Owner to assure himself that fill and backfill complies with material and compaction requirements in the specifications. Control tests of masonry work shall be made at the Owner's expense in accordance with directions issued by the Owner or Architect.
7. Testing of structural welds shall be made at the Owner's expense in accordance with other specific sections of the specifications.
8. Control tests of asphaltic concrete paving and base course shall be made at the Owner's expense by the Geotechnical Engineer Laboratory. The Geotechnical Engineer will make sufficient tests to assure himself that asphaltic concrete paving and base course complies with material and compaction requirements in the specifications.
9. Other testing:
    a. Any other tests required by specific sections of the Contract Documents to be paid for by the contractor.
    b. Any additional tests required because of any tests that fail.
    c. Proof of Noncompliance: Contractor liable for corrective action which Architect feels is required including complete removal and replacement of defective material.
    d. Material Substitution: Any tests of material or equipment offered as substitute for specified item on which a test may be required in order to prove its compliance with specifications.

10. Records: The contractor shall document and maintain records of all inspections and tests performed whether by the Owner's separate consultants or as required by specific sections of the specifications.

01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

A. Summary: This Section includes a description of temporary construction facilities and controls required by the contractor to facilitate construction including temporary electricity and lighting, temporary heat/enclosures, temporary water, temporary sanitary facilities, temporary protective facilities, elevators, scaffolding/runways, construction fence, and temporary controls.

B. Reference Standards/Minimum Criteria: All temporary facilities shall be installed as required by applicable code, OSHA, laws, or ordinances.

C. Restrictions/Critical Criteria:

1. Temporary electricity and lighting shall be provided by the contractor and removed upon completion and operation of permanent electrical service/distribution and permanent lighting. Receptacles shall not be used for construction power.
   a. Includes temporary electrical service and meter.
   b. 120/240 volt, 1 phase, 3 wire.
   c. Sufficient circuits and duplex 120v single phase outlets located that any part of the work can be reached with a 75 ft. extension cord to accommodate normal power tools and supplemental lighting.
   d. Temporary light to levels and as required by governing regulations but not less than minimum 5 footcandle illumination in all areas accessible to workers during hours they are at the job; minimum 10 footcandles for shop areas; 20 footcandles or more where detailed or finishing work is being done, supplemented as may be required.
   e. Provide additional exterior and interior lighting as required for warning, public safety, and project security.
   f. Contractor shall pay for all electricity used through temporary and permanent systems up to date of substantial completion for new construction. For renovation projects where the existing electrical service will be available, the Owner will pay for electricity used.
   g. Use of permanent systems criteria:
      1) Contractor responsible for damage to permanent wiring or fixture as a result of temporary use and shall replace receptacles and device plates showing wear.
      2) Clean permanently installed light fixtures using methods recommended by manufacturer.
      3) Remove temporary lamps and replace with new lamps at completion of the work.

2. Temporary heat and enclosures required by Contractor
   a. Temporary Heat: Provide temporary heat necessary for execution of work. Install, maintain and operate temporary heating apparatus in manner to facilitate work, so work can continue and such that finished work will not be damaged. No fuel type of any kind (gas, propane, etc.) shall be stored inside of building.
   b. Enclosures: Provide temporary enclosures necessary for holding temporary heat for masonry and concrete work and for thawing frozen ground.
   c. After the building is entirely and permanently enclosed and a permanent heating system is installed and capable of being adequately controlled, the permanent heating system may be used to provide heat for the building subject to approval of the Owner and Architect. Contractor shall pay for gas and electricity used in connection with the operation up to the date set in the Certificate of Substantial Completion. For renovation projects where the existing permanent heating system will be used, the owner will pay for the gas/electricity used. In using the permanent heating system, Contractor shall assume complete responsibility for its proper operation and for correction of any damage which may occur to permanent heating system.

Use of permanent heating system by Contractor shall in no manner compromise the warranty of the system. Warranty of the system will commence at date set in the Certificate of Substantial Completion.

3. Temporary Water: Contractor shall provide water required in the work as well as temporary connection, plumbing, piping, etc., necessary to convey same to places needed. Bulk water for site grading shall be provided by site grading contractor.
4. Temporary Sanitary Facilities: Contractor shall provide and maintain, in a neat and sanitary condition, adequate chemical toilet facilities for the use of employees engaged in the work. Any graffiti vandalism on sanitary facilities shall be removed immediately by the Contractor.
5. Temporary Protective Facilities/Scaffolding and Runways: Contractor to provide and maintain protective devices and facilities for protection of public and general protection of workmen on project.
    a. Provide and maintain fire extinguishers and active fire hydrants where required. Maintain fire lanes to hydrants and other equipment as necessary for proper fire protection during construction.
    b. Provide temporary walks, scaffolding, platforms, roadways, trench covers, barricades, bulkheads, railings, danger lights and signals, etc. required for work by applicable safety laws and building codes.
    c. Maintain temporary protective facilities in good condition throughout term of work. Remove at completion of work. Repair and replace work damaged by temporary protective facilities.

6. Elevators: Usage of any elevator by the Contractor shall not affect any conditions of warranty or warranty period for elevators as specified.
7. Construction Fence: Contractor shall erect construction fencing as indicated for protection of the public. The fence shall be 6'0" high, constructed of chain link with steel posts at 8'-0" on center, maximum. Top of fence fabric shall be knuckled for safety. Provide gates where required. Gates shall be kept closed and locked after working hours. At completion of exterior work, fences shall be removed from the site.
8. Field Office and Other Temporary Structures: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the project site. Keep the office clean and orderly for use for small progress meetings.
9. Security: Provide security program and facilities to protect work from unauthorized entry, vandalism, and theft. Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrance to prevent unauthorized entrance, vandalism, theft and similar violations of security. Verify with owner if a full time security person is required at the site for times when work is not in progress.
10. Temporary Controls - by Contractor:
    a. Noise Control: Minimize noise at all times near residential areas. All equipment shall be properly muffled. Do not operate noise equipment after hours.
    b. Dust Control: When construction procedures result in dust which becomes a nuisance to the Owner, private property, or traffic, control said dust.
    c. Water Control: Provide such means as necessary to control flow of water at the work to prevent damage to the Owner's property and adjacent property.

d. Debris Control: Continually police the work to prevent collection and scattering of debris, loose debris, or debris caused by execution of the work.
e. Pollution control: Take extreme caution to prevent spilling or littering of water polluting substances. Do not pump any foreign materials into the sanitary or storm sewer collection systems. Provide such labor, equipment, and materials as necessary to remedy such pollution. No burning of debris, nor any other air polluting methods or equipment, shall be allowed.
f. Erosion Control: Provide such facilities as might be necessary to prevent erosive damage to the Owner's property or to adjacent properties.

01 71 23 - FIELD ENGINEERING

PART 1 - GENERAL

A. Summary: This Section includes Field Engineering Services.

B. Referenced Standards/Minimum Criteria: Professional engineer or land surveyor performing field engineering services shall be registered in the State of Colorado. Professional engineer or land surveyor may be employee of the Contractor.

C. Submittals Required:
1. Surveyor/Engineer: Contractor to submit name and address of surveyor or professional engineer to be employed by Contractor for review by Owner and Architect before beginning work at the site.
2. Documentation and Records: Surveyor or engineer employed by contractor shall maintain a complete and accurate log of all control and survey work as it progresses. On request of the Architect, submit documentation of field engineering work.
3. Completion Certificate: Upon completion of the work, contractor shall submit to Architect a certificate signed by surveyor or engineer employed by Contractor certifying that elevations and locations are in conformance or non-conformance with Contract Documents.

D. Restrictions/Critical Criteria:
1. Engineer or land surveyor employed by contractor shall be responsible for location of building and major site elements, location of drilled piers, centerline and offset staking for utility lines, installation of control stakes for site grading as required and final certification that finish grading has been completed within the tolerances specified.
2. Permanent Bench Marks: Engineer or Surveyor employed by Contractor shall establish a minimum of two permanent bench marks on the site, referenced to data established by survey control points.
3. Preservation of Monuments and Stakes: Contractor shall carefully preserve all monuments, bench marks, property markers, reference points, and stakes. Permanent monuments or bench marks which must be removed or disturbed shall be protected until properly referenced for relocation.

01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

A. Summary: This Section includes:
   1. Project Record Documents
   2. Substantial Completion
   3. Final Observation and Acceptance
   4. Closeout Submittals
   5. Final Completion and Final Payment
   6. Demonstrations
   7. Mechanical Service and Maintenance
   8. Post Construction Inspection

B. Submittals Required (Contract Close-out):
   1. Evidence of Payments and Release of Liens
      a. Affidavit of Payment of Debts and Claims: AIA G706
      b. Affidavit of Release of Liens: AIA G706A
      c. Consent of Surety to Final Payment: AIA G707

   2. Written Warranties:
      a. A written warranty addressed to the Owner, properly signed and notarized, warranting that the Contractor and each subcontractor shall remedy any defects due to faulty materials or workmanship and pay for consequential damage resulting there from, which appear in his work within a period of one (1) year from the Date of Substantial Completion.
      b. Warranties as specified in individual sections of the Specifications. All warranties shall include the name and address of the Contractor, subcontractor or supplier, the project name, and the item(s) being warranted. Warranties specified under individual sections of the Specification for periods longer than one (1) year shall include payment for consequential damage due to faulty materials or workmanship for full duration of warranty.
      c. Inspection Certificates: Each subcontractor shall, upon completion of the work, secure in triplicate all certificates from any State or local governing body having jurisdiction in dictating that the work is in strict accordance with applicable codes and deliver same to the Contractor for transmittal to the Architect.
      d. Record Drawings and Record Project Manual: Deliver Record Documents to Architect with transmittal letter containing date, project title and number, contractor's name and address, title and number of each record document. Include certification letter that each document is complete and accurate. Submittal shall be signed by Contractor or his authorized representative.
      e. Asbestos Containing Material: Provide a letter certifying that to the best of the Contractor's knowledge and belief, no asbestos containing materials have been incorporated into this project.
      f. Maintenance Manuals: Furnish, in three (3) copies, indexed, in hard cover 3-ring binder with complete literature, complete operating instructions and technical data on all products or equipment requiring same.

g. Sales and Use Tax Certificates.
h. Miscellaneous Keys, Switches, Etc.: All loose keys for hose bibs, adjustment keys and wrenches for door closers and panic hardware, keys for electric switches, electrical panels, etc., shall be accounted for, labeled, and turned over to the Owner. Provide evidence of delivery to Owner by signed receipt.
i. Spare Parts and Materials: As specified in individual sections. Deliver to Owner stating amounts of materials delivered (number of gallons, cases, etc.). Provide evidence of delivery to Owner by signed receipt.

C. Restrictions/Critical Criteria:
1. Project Record Documents: Contractor to maintain at the job site, one (1) record copy of the following:
a. Drawings
b. Project Manual
c. Addenda
d. Reviewed and Accepted Shop Drawings and Product Data
e. Change Orders
f. Other Modifications to Contract
g. Field Test Records

2. Contractor to record following information on the Record Drawings:
a. Location of all new exterior underground utility lines
b. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure
c. Field changes of dimension and detail
d. Changes by addendum, change order, or field order
e. Details not on original contract drawings

3. Contractor to record following information in the Record Project Manual:
a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment in each section actually installed
b. Changes by addendum, change order or field order
c. Other matters not originally specified

4. Substantial Completion:
a. The Contractor submits written verification that project is substantially complete along with Contractor's own Punch List describing remaining incomplete work or work requiring correction
b. Should the Architect concur that the work is substantially complete, he will prepare a Punch List that need to be corrected before Final Observation. A Certificate of Substantial Completion with the deficiencies noted will then be issued by the Architect

5. Final Observation and Acceptance:
   a. The Contractor submits written verification:
      1) Project has been inspected for compliance with Contract Documents
      2) Work has been completed in accordance with Contract Documents
      3) Equipment and systems have been tested in the presence of Owner's Representative and are operational
      4) Project is completed and ready for Final Observation

   b. Upon receipt of written certification that project is complete, the Architect shall visit the site for purposes of determining completion of the work

6. Final Completion and Final Payment: Contractor shall submit final Application for Payment to the Architect in accordance with the requirements of the General and Supplementary Conditions. Application shall not be submitted until all contract closeout requirements have been met.
7. Demonstrations:
   a. Mechanical Systems: Contractor/Mechanical Subcontractor shall instruct the Owner's representative(s) once on the proper operation and maintenance of the mechanical systems. As a minimum, presenting participants shall include Mechanical Contractor, Controls Subcontractor, and major equipment manufacturer's representative. The Design Engineer shall attend this demonstration
   b. These instructions shall be video recorded by the Contractor. At the completion of the instructional periods, a DVD of the video shall be turned over to the Owner for future reference
   c. Electrical Systems: Contractor/Electrical Contractor shall instruct the Owner's representative(s) twice on the proper operation of the entire electrical installation, including any and all special systems provided under this contract. One of the instruction periods shall be for building users.

Include the following minimum number of sessions and hours of instruction to be conducted by the manufacturer's representatives:

	High S.	Middle S.	Elem S.
Fire Alarm System	2 at 2 Hours	2 at 2 Hours	2 at 2 Hours
Emergency Generator	2 at 1 Hour	2 at 1 Hour	2 at 1 Hour
Clock System	2 at 1 Hour	2 at 1 Hour	2 at 1 Hour
Sound Systems/Intercom	4 at 4 Hours	3 at 4 Hours	2 at 4 Hours
Commons Dimming System	2 at 1 Hour	2 at 1 Hour	2 at 1 Hour
Lighting Controls	2 at 2 Hours	2 at 2 Hours	2 at 2 Hours
Auditorium Dimming System	2 at 5 Hours	NA	NA

The demonstration session for the Special Systems to building users shall be video recorded by the Contractor. A DVD of the video of this session shall be turned over to the Owner for future reference.

8. Mechanical Service and Maintenance: Contractor shall include four (4) complete service and maintenance calls plus emergency calls spaced at reasonable intervals throughout one (1) year warranty period.

   In addition to service calls, the Contractor shall meet with the Owner's representative and Mechanical Engineer at the Building at 3 and 11 months following final Date of Substantial Completion to review warranty items and performance of HVAC systems.

9. Post-Construction Inspection: Prior to expiration of one (1) year from Date of Substantial Completion, the Owner, Architect and Contractor will tour the project to determine whether corrective warranty work is required. Contractor will be notified in writing of all deficiencies. Contractor must correct noted deficiencies within ten (10) days of receipt of notification.

END OF SECTION

DIVISION 02 – EXISTING CONDITIONS

02 41 19 – SELECTIVE DEMOLITION

PART 1 - GENERAL

A. Summary - Section includes:
   1. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

B. Referenced Standards/Minimum Criteria:
   1. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this project.
   2. Refrigerant Recovery Technician Qualifications: Certified by an EPA approved certification program.
   3. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
   4. Standards: Comply with ANSI / ASSP A10.6-2006 (R2016) "Safety and Health Program Requirements for Demolition Operations" and NFPA 241 "Standard for Safeguarding Construction, Alternation, and Demolition Operations".
   5. Predemolition Conference: Conduct conference at Project site. Review methods and procedures related to selective demolition including, but not limited to, the following:
      a. Inspect and discuss condition of construction to be selectively demolished.
      b. Review structural load limitations of existing structure.
      c. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
      d. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
      e. Review areas where existing construction is to remain and requires protection.

C. Submittals Required:
   1. Schedule of Selective Demolition Activities: Indicate the following:
      a. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
      b. Interruption of utility services. Indicate how long utility services will be interrupted.
      c. Coordination for shutoff, capping, and continuation of utility services.
      d. Locations of proposed dust-and noise-control temporary partitions and means of egress.
      e. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
      f. Means of protection for items to remain and items in path of waste removal from building.

2. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
3. Predemolition Photographs / Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damaged caused by selective demolition operations.

D. Restrictions/Critical Criteria:
1. Owner may occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
2. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
3. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
4. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
    a. Arrange to shut off indicated utilities with utility companies.
    b. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
    c. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

5. Removed and Salvaged Items:
    a. Clean salvaged items.
    b. Pack or crate items after cleaning. Identify contents of containers.
    c. Store items in a secure area until delivery to Owner.
    d. Transport items to Owner's storage area designed by Owner or as indicated on Drawings.
    e. Protect items from damage during transport and storage.

6. Removed and Reinstalled Items:
    a. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
    b. Pack or crate items after cleaning and repairing. Identify contents of containers.
    c. Protect items from damage during transport and storage.
    d. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

7. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
8. Recycle existing materials to the greatest extent possible.
9. Ownership of salvageable material/equipment to be determined by School District. Typical owner salvaged items might include:
    a. Door hardware.
    b. Markerboards, tackboards.
    c. Cabinets, countertops.
    d. Wall shelving.
    e. Mechanical units, equipment.
    f. Electrical panels, breakers.
    g. Clock/bell/intercom components.
    h. Fire/security detection and alarm components.
    i. Emergency generator.

PART 2 - PRODUCTS

A. Not Applicable.

END OF SECTION

DIVISION 03 - CONCRETE

03 05 10 – MOISTURE VAPOR REDUCTION ADMIXTURE

PART 1 - GENERAL

A. Summary - Section includes:
   1. Application of Moisture Vapor Reduction Admixture (MRVA) at all new interior concrete slab areas except in the crawl space and the main level slabs in rooms with pigmented concrete.

B. Referenced Standards/Minimum Criteria:
   1. Certification of compliance with ASTM C494 /C494M testing protocols from an independent AASHTO approved laboratory.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Ready Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
      a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

   2. Moisture Vapor Reduction Admixture Collection Agent / Representative Qualifications
      a. Personnel conducting field sampling on behalf of the MVRA manufacturer shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

   3. Slab Moisture Testing and Evaluation: Personnel performing laboratory tests shall be certified in the conduct of ASTM D5084 under the supervision of a licensed geotechnical engineer. The determination as to whether the concrete slab is prepared to receive flooring, coatings, roofing, etc. rests with the MVRA manufacturer.
   4. Source Limitations: Obtain each type of concrete moisture vapor reducing
   5. ACI Publications: For slabs to receive moisture sensitive coatings or material, comply with the following unless modified by requirements in the Contract Documents:
      a. ACI 302.2R-06, "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring".

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Barrier One High Performance Moisture Vapor Reduction Admixture" by Barrier One, Inc. www.barrierone.com.
   2. "MVRA 900" by ISE Logik Industries: www.iselogik.com.
   3. Approved substitute.

03 10 00 – CONCRETE FORMWORK

PART 1 - GENERAL

A. Summary - Section includes:
   1. Concrete formwork materials.
   2. Formwork accessories.
   3. Underslab gravel bed.
   4. Miscellaneous materials.

B. References Standards/Minimum Criteria:
   1. Design and construction shall follow recommendations of ACI 301-16 "Specifications for Structural Concrete" and ACI 117-10 "Specifications for Tolerances for Concrete Construction".
   2. Camber: Design formwork to have sufficient camber to maintain the tolerances specified. Camber shall be sufficient to compensate for the weight of the fresh concrete and a construction liveload of 20 psf.
   3. Safety: Contractor shall assume all responsibility for the safety of the formwork and shall provide necessary design, construction, materials, and maintenance to produce the required concrete work safely.
   4. Shoring: Design shoring for elevated structural slabs to support total wet weight of concrete, reinforcement, and construction liveload of 20 psf.

C. Restrictions/Critical Criteria:
   1. The use of earth as a form will not be allowed. Lap forming with dressed lumber or plywood will not be allowed. Forms shall conform to shape, lines and dimensions of the members shown on the drawings and shall be substantial and sufficiently tight to prevent leakage of concrete. Properly brace or tie to maintain position, shape, and lateral stability, and provide sufficient strength to carry construction operations and material dead loads without deflection or vibration. Forms shall be designed to be capable of needed adjustments. Where finished concrete is to remain exposed, joints shall be regularly spaced and held to a minimum both horizontally and vertically. Provide access panels in formwork for cleanout or pouring as required. Install voids where required.
   2. Include underslab vapor barrier and underslab gravel bed when recommended by the Geotechnical Engineer. Design according to Geotechnical Engineer's recommendations.
   3. Control joints in concrete slabs on grade shall be per the layout on the drawings or maximum spacing per ACI 301. Reinforcing shall extend through joints unless noted otherwise. Sawed joints may be substituted for joint forms at control joints. Sawed joints shall be 1/4 of the slab thickness. Saw cutting shall be started as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and shall be completed before shrinkage stresses have developed sufficiently to induce cracking.
   4. Shoring and forming of elevated concrete slabs shall be kept in place until tests indicate concrete has achieved minimum strength of 3,000 psi.

PART 2 - PRODUCTS

A. Acceptable:
   1. Exposed Concrete: New 8-8 Plyform, 4-foot x 8-foot sheets.
   2. Non-Exposed Concrete: Plywood, steel, or dressed lumber.
   3. Form Ties: Adjustable in length to permit tightening of forms and of such type to leave no metal closer than 1-inch to the surface nor holes or depressions larger than 7/8-inch in diameter.
   4. Form Oil: Non-staining.
   5. Slab Edge Premolded Filler: Bituminous fiber type in accordance with ASTM D1751.
   6. Fiber Voids: Grade beam void forms shall be "SureVoid Products" from VoidForm Products, Inc., Englewood, CO; or approved substitute.
   7. Slab Expansion and Construction Joint Forms: "Keyed Kold" from Burke Concrete Accessories, Inc. or approved substitute.
   8. Waterstops: "Greenstreak PVC Waterstop" from Sika USA, or approved substitute.
   9. Underslab Gravel Bed if required by the geotechnical engineer: Clean, granular fill, pit run gravel. Minimum 3/4-inch aggregate.
   10. Slab Premolded Expansion and Control joint Fillers: "The Original Zip Strip" by Superior Profiles, or approved substitute.

03 20 00 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Concrete reinforcing steel.
   2. Bar supports and spacers.
   3. Tie wire.
   4. Welded wire fabric.

B. Referenced Standards/Minimum Criteria:
   1. Detailing, fabrication, and placement: Follow ACI 301 "Specifications for Structural Concrete", ACI 315 "Guide to Presenting Reinforcing Steel Design Details", and ACI 318 "Building Code Requirements for Structural Concrete and Commentary" (latest editions).
   2. Bar Bending Details and Placing Drawings: In accordance with the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (latest edition).
   3. Welded Wire Fabric: Conform to ASTM A1064.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Provide 24 hours minimum notice to the Architect to allow his observation of concrete reinforcement before placing concrete.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. No specific requirements.

03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

A. Summary - Section includes:
   1. Cast-in-place concrete.

B. Referenced Standards/Minimum Criteria:
   1. ACI 301 (latest edition).
   2. ACI 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete" (latest edition).
   3. Cold Weather Placement ACI 306R "Guide to Cold Weather Concreting" (latest edition).
   4. Hot Weather Placement ACI 305.1 "Specification for Hot Weather Concreting" (latest edition).
   5. General: Use ready-mixed concrete conforming to ASTM C94-19 "Standard Specification for Ready-Mixed Concrete". No on-job mixed concrete will be allowed.
   6. Cement: Conform to ASTM C150-19a "Standard Specification for Portland Cement", type of cement per geotechnical engineer.
   7. Aggregates: Fine aggregate (natural sand) and coarse aggregate (gravel or crushed stone), shall conform to ASTM C33-18. Maximum coarse aggregate size shall be as indicated in mix design.
   8. Bonding Agent: ASTM C1059-13 and ASTM C881-15 for epoxy bonding adhesive.
   9. Air Entraining Agent: Conform to ASTM C260-16.
   10. Chemical Admixtures: Conform to ASTM C494-19.
   11. Mineral Admixtures: Conform to ASTM C618-19.
   12. Curing Compound: Conform to C309-19, Type 1.
   13. Use and Type of Mechanical Vibrators: Conform to ACI 309-19.
   14. Fly ash if approved by the Owner, ASTM C618-19, Class for Class C.
   15. Control tests by testing laboratory employed by the School District; in accordance with ASTM C138-17a, ASTM C143-15a, ASTM C173-16, ASTM C231-17a, and ASTM C1064-17. Curing of test cylinders per ASTM C31-19a and ASTM C172-14a. Control tests of concrete work shall be on every fifty (50) cubic yards or fraction thereof of concrete placed. A minimum of once during each day's pour. Samples shall be taken only after any extra water has been added and thoroughly mixed. Each test shall consist of six (6) inch test cylinders cast and cured in accordance with ASTM C31-19a and ASTM C172-14a. Two (2) cylinders shall be broken at the end of seven (7) days after placing, two (2) cylinders shall be broken at the end of 28 days after placing, and the remaining two (2) cylinders shall be stored until their disposition is determined by the Architect.
   16. Slump Tests: The Contractor shall provide necessary equipment and shall make tests in conformity with ASTM C143-15a. The Contractor shall keep an accurate record of the time, location in the work, and the results of slump tests which shall be available for inspection by the School District and the Architect.

C. Submittals Required:
1. Mix Designs: Prior to placing concrete, the Contractor shall submit concrete mixes to the Architect for approval. Submittals shall include all information used in designing the mixes.
2. Test Reports: Reports of control tests, special tests or core tests shall be distributed by the testing laboratory.
3. Contractor record listing time, date and temperature when concrete placement occurred.

D. Restrictions/Critical Criteria:
1. Additional Water: Deliver concrete to the job in exact quantities required by the design mix. Should additional water be required before placing concrete, the Contractor shall have sole authority to authorize the addition of water. Any added water shall not exceed the maximum water/cement ratio or maximum slump of the approved mix design. Any additional water added to the mix after leaving the batch plant shall be indicated on the truck ticket and signed by the Contractor.
2. General: Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow.
3. Protection: Protect newly finished concrete from rain or hail damage. Cover adjacent walls, glazing, and other finish materials with polyethylene sheeting or otherwise protect from damage due to placing of concrete.
4. No admixtures, accelerating mixtures, or water reducing agents shall be used by the Contractor unless authorized by the Architect.
5. Use fibrous reinforcing only in exterior sidewalks, curbs/gutters, concrete paving, and other site concrete as approved by the School District.
6. Tolerances: Per ACI 117-10 "Specification for Tolerances for Concrete Construction and Materials" requirements:
    a. Class AA Surface Finish Tolerance: Floors to receive seamless quartz flooring or wood floors shall meet Class AA surface tolerance of 1/8-inch in 10-feet.
    b. Class BX Surface Finish Tolerance: Concrete floors shall meet Class BX surface tolerance of 1/4-inch in 10-feet except where drains occur.
7. Finishes: The selection of finishes shall be in accordance with Section 11.8 of ACI Standard 301-16 "Specifications for Structural Concrete".
8. Curing Compound Application: Apply curing compound, the same working day that the forms are removed. Cover horizontal surfaces with polyethylene sheeting. Omit curing compound on concrete floors scheduled to receive seamless quartz flooring, ceramic tile, or resilient playing surface systems flooring.
9. Floor Sealing: Apply sealer to concrete floors not receiving other finishes.

PART 2 - PRODUCTS

A. Products/Materials are unrestricted provided they meet specified requirements.

03 35 43 – POLISHED CONCRETE FINISHING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Polished concrete finishing.
      a. Desired level of aggregate exposure is "Salt-and-Pepper".
   2. Concrete Stain (dye).
   3. Protection of concrete slabs to be stained and polished.

B. Referenced Standards/Minimum Criteria:
   1. Standards of the Concrete Polishing Association of America (CPAA).

C. Submittals Required:
   1. Product Data.
   2. Shop drawings.
   3. Samples for color selection.

D. Restrictions/Critical Criteria:
   1. The contractor shall be a licensed installer for the product and system specified, with not less than 3 years experience.
   2. An accredited member of the CPAA, or similar qualification.
   3. Mockups: Provide a mockup of each polished concrete finish indicated, to verify selections made under submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship.

E. Protection of Concrete Slabs to be Stained and Polished:
   1. Contractor and all sub-contractors shall take precautions to prevent damage and soiling of concrete slabs scheduled to be polished as final finish.
      a. The following substances can penetrate the surface and stain the slab: Red chalk, permanent markers, wax pencils, adhesives, oils, gas, primer, paint, stain, poly seal, caulk, PVC primer/cleaner, PVC adhesive, food, grease, beverages and rust from metal or nails.
      b. Lumber, wood boards, sawdust plywood, thermo-ply, pressboard, insulation board and plastic all draw moisture from the slab. If left, they can transfer resins, tannins and water stains to the slab.
   2. Precautions shall include but not be limited to:
      a. Prevent damage to floor slabs from substances listed in above paragraphs.
      b. Prohibit parking or driving of vehicles on concrete slab until protective cover is installed.
         1) If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid, or other liquids.
      c. Prohibit temporary placement and storage of steel members on concrete slab.

d. Install protective covering of heavy cardboard, rosin paper, hardboard, plywood, Masonite, or other protective sheeting over entire floor surface.
   1) 6 mil black plastic is acceptable, overlapping by one foot, and taped at the seams. Do not tape to the floor.

e. Prohibit pipe cutting and using pipe cutting machinery on concrete slabs.
f. Do not write on the slab with anything except light pencil.
g. Do not allow use of red chalk for lay-out lines.
h. Do not allow use of unprotected floors for lay down, staging, or use by any trades.
i. Floors must be completely protected during application of primer, paint, stain, or lacquer. Painters may use Green Tape, 24-hour tape, craft paper, or drop cloths to protect floor and the field. Only Green Tape or lacquer-free tape is acceptable for the protection of acid-stained floors. Do not leave tape down for longer than 72 hours as it can leave a residue or pull off sealed surfaces.
j. Keep area clean.

3. Coordinate requirements for concrete slab protection with polished concrete subcontractor to assure compliance with requirements.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Concrete polishing system based on materials and written procedures of the "FGS PermaShine Concrete Polishing System" by Laticrete www.laticrete.com. Comparable products, based on use with comparable concrete polishing system, by one of the following will also be considered.
      a. "Retroplate" by Advanced Floor Products: www.retroplate.com.
      b. "Certi-Shine" by Vexcon Chemicals: www.vexcon.com.
      c. Approved substitute.

B. Concrete Dye: "AmeriPolish Classic Dye" by Ameripolish: www.ameripolish.com, or as approved by Architect.
   1. Solvent-based, mixed with acetone which will not grind off during polishing.
   2. Colors: As selected by Architect.

03 41 00 – PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

A. Summary - Section includes:
   1. Structural precast concrete (design, fabrication and erection) including columns, beams, double-tees, etc.

B. Referenced Standards/Minimum Criteria:
   1. Precast Concrete Members: ACI 318-19 "Building Code Requirements for Structural Concrete" and AISC "Manual of Steel Construction" (latest edition).
   2. Welding: "Recommended Practices for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Construction" AWS D12.1, and AWS D1.4-2011 "Structural Welding Code – Reinforcing Steel" (latest edition).
   3. "Architectural Precast Concrete Manual" of the Precast / Prestressed Concrete Institute, (latest edition) for tolerance definitions and sketches.

C. Submittals Required:
   1. Certificate indicating precaster is a member of PCI.
   2. Shop drawings and setting diagrams.
   3. Design calculations.
   4. Quality Control Submittals: The manufacturer shall make available to the Architect, upon request, records of concrete cylinder breaks for concrete used in the precast concrete products and mill tests of reinforcing steel used.

D. Restrictions/Critical Criteria:
   1. Require Contractor to use only "AWS" certified welding operators.
   2. Design of precast units by precast manufacturer shall be under the direct supervision of a professional engineer registered in Colorado and shall bear his seal and signature.
   3. Fire Rating: As required for location and building type (1HR or 2HR).
   4. Design Loads: The precast manufacturer shall design units to support the live and dead loads as determined by the structural consultant/architect.
   5. Prestress Force: Tensioning and releasing of stressing strand may by either single or multiple procedures.
   6. Concrete Strength: Concrete strength and reinforcing strength shall conform to the requirements outline by the structural consultant/architect and in approved design calculations. Minimum 28-day compressive strength shall be at least 4,000 psi for precast elements.
   7. Erection: Installation of precast concrete shall be performed by the manufacturer or competent erection contractor specializing in the erection of precast. Lift members by means of suitable lifting devices at points by the fabricator. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Manufacturers: All precast concrete products shall be provided and erected under a single subcontract responsibility. Any of the following manufacturers will be acceptable:
   1. Stresscon Corporation: www.strasscon.com.
   2. Rocky Mountain Prestress: www.rmpprestress.
   3. Approved substitute.

03 45 00 – PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

A. Summary - Section includes:
   1. Precast concrete exterior seating units.
   2. Precast copings, sills, and other trim.

B. Referenced Standards/Minimum Criteria:
   1. Quality-Control Standard: For manufacturing procedures and testing requirements, quality- control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
   2. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

C. Submittals Required:
   1. Design Mixtures.
   2. Shop drawings.
   3. Samples.

D. Restrictions/Critical Criteria:
   1. Provide full-sized mock-up on site.

E. Reinforcing Materials:
   1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
   2. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) or ASTM A 706/A 706M deformed bars, with ASTM A 767/A 767M, Class II zinc coating and chromate treatment.
   3. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) or ASTM A 706/A 706M, deformed bars, assembled with clips.
   4. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized- steel wire into flat sheets.

F. Concrete Materials:
1. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.
a. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

2. Supplementary Cementitious Materials:
a. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
b. Metakaolin: ASTM C 618, Class N.
c. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
d. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

PART 2 - PRODUCTS

A. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

B. Acceptable Manufacturers/Products:
1. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
a. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.

03 60 00 – GROUT

PART 1 - GENERAL

A. Summary - Section includes:
1. Non-shrink grout.

B. Referenced Standards/Minimum Criteria:
1. ASTM C1107-17 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout".

C. Submittals Required:
1. Product data.

D. Restrictions/Critical Criteria:
1. Mix and install grout according to manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Masterflow 928" by Master Builders: www.master-builders-solutions.com.
   2. "Five Star Grout" by Five Star Products, Inc. www.fivestarproducts.com.
   3. "L&M Crystex" by Laticrete International, Inc. www.laticrete.com.
   4. Approved substitute.

END OF SECTION

DIVISION 04 - MASONRY

04 05 13 – MORTAR AND MASONRY GROUT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Masonry mortar.
   2. Masonry grout.

B. Referenced Standards/Minimum Criteria:
   1. Portland cement: ASTM C150-19a "Standard Specification for Portland Cement", Type 1
   2. Hydrated lime: ASTM C270-19 "Standard Specification for Mortar for Unit Masonry", Type S or Type N
   3. Aggregate for mortar: ASTM C144-18 "Standard Specification for Aggregate for Masonry Mortar".
   4. Aggregate for grout: ASTM C404-18 "Standard Specification for Aggregate for Masonry Grout".
   5. Ready mix grout: ASTM C476-19 "Standard Specification for Grout for Masonry", Grout tests will be conducted by a testing laboratory selected and paid by the School District. Testing in accordance with ASTM C1019-19 "Standard Test Method for Sampling and Testing Grout for Masonry".
      a. Testing Requirements: Minimum of one (1) sample (3 specimens) for each 5,000 square feet of masonry wall area.

C. Submittals Required:
   1. Mortar mix designs.
   2. Grout mix designs.
   3. Color options for mortar colors.

D. Restrictions/Critical Criteria:
   1. Accelerators and Antifreeze Compounds: Not permitted.
   2. Other Admixtures: Only with permission of Architect.
   3. Verify with School District the use of colored mortar versus standard gray mortar.
   4. Coarse Grout: Coarse grout may be used only in grout spaces in brick masonry 2-inches or more in horizontal dimension and grout spaces in filled-cell construction 3-inches or more in both horizontal dimensions. Coarse grout shall be composed of one-part Portland cement with not more than one-tenth part hydrated lime or lime putty added, and two to three parts sand, and not more than two parts gravel.
   5. Fine Grout: Use fine grout in all locations where coarse grout may not be used. Fine grout shall be composed of one-part Portland cement, with not more than one-tenth part hydrated lime or lime putty added, and two and one-fourth to three parts sand.
   6. Grout shall attain a minimum strength at 28 days of 2,000 psi or as determined by structural consultant.
   7. Use water-repellant additive for mortar used in conjunction with CMU specified with water- repellant additives per manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Materials:
   1. Portland Cement: Type I. Masonry cement not allowed unless approved by the School District.
   2. Hydrated Lime: Type S or N.
   3. Aggregates for Mortar: Clean well washed sand. Sand shall be free from deleterious amounts of acids, alkalies, or organic materials.
   4. Aggregates for Grout: Clean well washed sand. Sand shall be free from deleterious amounts of acids, alkalies, or organic materials.
   5. Water: Potable.
   6. Colors: Standard color as selected by Architect.
   7. Mortar Color: As manufactured by one of the following:
      a. Tamms Industries: www.euclidchemical.com.
      b. Solomon Grind-Chem Service, Inc. www.solomoncolors.com.
      c. Lafarge-Holcim Ltd. www.lafarge-holcim.com.
      d. Approved substitute.

B. Acceptable Mixing Methods:
   1. Site or ready-mixed grout for masonry.

04 05 19 – MASONRY ACCESSORIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Wall ties, anchors and reinforcing
   2. Weep materials
   3. Control joints
   4. Masonry flashing
   5. Column isolation material
   6. Glass block unit reinforcing

B. Referenced Standards/Minimum Criteria:
   1. Wall ties and reinforcing:
      a. ASTM A153-16a "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware" - Class B2 at exterior/cavity walls.
      b. ASTM A641-19 "Standard Specification for Zinc—Coated (Galvanized) Carbon Steel Wire", Class 1 for interior walls.

C. Submittals Required:
   1. Product data for all component items.

D. Restrictions/Critical:
   1. Install masonry accessories per standards of the Brick Institute of America and National Concrete Masonry Association.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Wall Ties and Reinforcing:
   1. Hohmann & Barnard, Inc. www.h-b.com.
   2. Approved substitute

B. Acceptable Products: Provide products by Hohmann & Barnard as listed or approved substitute:
   1. Horizontal Reinforcing: Use prefabricated corners and tees. Type as follows:
      a. Single Wythe Walls: "220 Ladder Mesh".
      b. Cavity Walls: "270 Ladder Lox-All Adjustable Eye-Wire".
      c. Composite Walls: "230 Ladder-Tri-Mesh".

   2. Dovetail Anchors: "315 Triangular Tie" or similar of other manufacturer. Provide 22-gauge dovetail anchor slots for anchors.
   3. Masonry Veneer Wall Ties:
      a. At Stud Walls: "HB-200/DA-213 Adjustable Veneer Anchor" or similar of other manufacturer.
      b. At Concrete or Concrete Masonry Walls: "2-Seal Concrete Seal Tie" or similar of other manufacturer.

   4. Ties at Structural Steel Beams and Columns: "359 Weld-On Tie" or "359-C Weld-On Tie".
   5. Weep Material: 3/8-inch o.d. clear plastic with insert screen, cotton rope or manufactured joint drain system.
   6. Control Joints: 3/8-inch thick non-asphaltic fiberboard.
   7. Masonry Flashing:
      a. Self-adhesive, rubberized asphalt/polyethylene through-wall flashing for cavity wall applications "Textroflash Flashing" by Hohmann & Barnard, "Perm-A-Barrier" by Grace Construction Products Applied Technologies, or similar of other manufacturer.
      b. Stainless Steel Flashing: Flexible stainless-steel fabric flashing, Class A material consisting of a layer of polymeric fabric with a single sheet of 304 stainless steel bonded to one side. "Mighty-Flash" by Hohmann & Barnard or "Multi-Flash SS" by York Flashings, or similar product by other manufacturer.

   8. Column Isolation: 1-inch thick, semi-rigid fiberglass.

C. Acceptable Manufacturers of Glass Block Reinforcing and Materials: Pittsburgh Glass Block Co. www.pittsburghglassblock.com, or approved substitute.
   1. Panel Reinforcing: Two parallel 9-gauge wires at two (2) inches on center with butt-welded cross-wires spaced at regular intervals, galvanized after welding.
   2. Expansion Strips: 3/8-inch thick fibrous glass or polyethylene foam.
   3. Panel Anchors: 20 gauge perforated steel strips 1-3/4-inch wide x 24-inches long, galvanized after perforation.

04 20 00 – UNIT MASONRY

PART 1 - GENERAL

A. Summary - Section includes:
   1. Sample masonry panels.
   2. Brick veneer masonry.
   3. Concrete block masonry.
   4. Glass unit masonry.
   5. Acoustical block.
   6. Reinforced unit masonry.
   7. Sand filled block walls.
   8. Integrally colored regular face block masonry.
   9. Integrally colored split face block masonry.

B. Referenced Standards/Minimum Criteria:
   1. Preconstruction masonry prisms (8) shall be constructed and tested by testing agency employed by School District in accordance with ASTM C1314-18 "Standard Test Method for Compressive Strength of Masonry Prisms".
   2. Masonry work: Strictly require compliance with requirements/standards/technical recommendations of the Brick Institute of America and the National Concrete Masonry Association.
   3. Masonry installer must have completed the masonry certification program of the Rocky Mountain Masonry Institute.
   4. Construction tolerances and quality/location of control and expansion joints shall, as a minimum, be per the standards of the Brick Institute of America and the National Concrete Masonry Association.
   5. Brick: Conform to ASTM C216-19 "Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)", Type FSB, Grade SW.
   6. Lightweight hollow and load-bearing concrete block for interior locations: Conform to ASTM C90-16a "Standard Specification for Loadbearing Concrete Masonry Units", aggregate to ASTM C331-17 "Standard Specification for Lightweight Aggregates for Concrete Masonry Units".
   7. Medium weight integral colored split face, ground face, smooth face and regular block: Conform to ASTM C90-16a "Standard Specification for Loadbearing Concrete Masonry Units".
   8. Glass block units: Fire rating as required for location.

C. Submittals Required:
   1. Samples required for different masonry units (including colors).
   2. Product data/specifications required for each type of masonry unit certifying that masonry unit meets ASTM requirements.
   3. Test reports of masonry prism tests.
   4. Fire test reports for glass block: Tests per ASTM and Underwriters Laboratories (UL).

D. Restrictions/Critical Criteria:

1. Split face or heavy textured masonry units not recommended for interior use due to safety and maintenance issues.
2. Unit masonry shall be covered with metal flashing or caps at the top of all parapet walls.
3. Reveals and recessed courses are not recommended due to safety issues (increased possible climbing activities).
4. Below grade transitions between masonry and other materials not recommended. Provide waterproofing and drainage when unavoidable and authorization by the School District.
5. Mock-Ups: Furnish materials specified in sufficient quantities to construct a minimum of two (2) 4' x 4' masonry sample wall panels. Make such modifications as necessary to achieve panels satisfactory to the Architect and School District. The panels shall be erected at a location on the site to be designated by the Architect and shall be maintained by the Contractor until project is completed. Sample panels shall be cleaned and sealed with water repellent coating prior to review by Architect.
6. Protection of Completed Work from Physical Damage: Protect projecting masonry susceptible to damage after setting by suitable planking well supported. Jambs and sill of openings used for passage shall be securely boxed. Replace masonry work showing damage or disfiguration during the progress of work in its entirety. No patching or hiding of defects will be permitted.
7. Provide horizontal flashings at critical exterior wall locations including, but not limited to, heads of openings, weep locations, bond beams, and penetrations. Provide end dams where flashings meet other wall systems or grouted vertical cells.
8. All exterior masonry to be sealed or coated with anti-graffiti coating - see Division 07.
9. Where cutting of units is necessary, make cuts with a mortar-driven masonry saw.
10. Brick/Block Veneer: Where brick or block veneer occurs over stud walls, bond to steel studs with brick veneer ties. Keep cavities behind brick or block veneer free of mortar droppings to facilitate drainage to the outside of the wall.
11. Steel Door Jambs: Steel door jambs set in masonry shall have jambs grouted full of mortar as wall is built.
12. Reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Maintain a clear, unobstructed vertical opening area measuring not less than 2-inches x 3-inches. Hold vertical reinforcement in position at top and bottom and at intervals not exceeding 192 bar diameters. Fill cells containing reinforcement solidly with grout. Pour grout in 4-foot maximum lifts. Consolidate grout at time of pouring by mechanical vibration. Reconsolidate by mechanical vibration to minimize voids due to water loss.
13. Sand Filled Block Walls: Fill block cores without reinforcing in 4-foot lifts with washed dry sand as the wall is laid up except cores with reinforcing. Sand fill behind outlets, fire alarm horns, drinking fountains, and other built-in items.
14. Daily Cleaning of Masonry: Make every effort to keep masonry work as clean as possible during construction. At a minimum, dry brush masonry surfaces after mortar has set at end of each day's work and after final pointing.

15. Final Cleaning of Masonry:
    a. Clean mortar, dirt and construction film from masonry using stiff brush and water when mortar is at least 7 days and not more than 14 days old.
    b. Remove efflorescence or other stain in accordance with masonry unit manufacturer's recommendations.
    c. No high pressure or muriatic acid cleaning of brick or block will be permitted.
    d. Deviations from the water cleaning process must be requested in writing and approved by the Architect and School District prior to the start of masonry work.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
    1. Face Brick:
        a. Lakewood Brick & Tile Co. www.summitbrick.com.
        b. Summit Brick Company: www.summitbrick.com.
        c. Denver Brick Co. www.denverbrick.com.
        d. General Shale: www.generalshale.com.
        e. Approved substitute.

    2. Lightweight Concrete Block:
        a. Baselite Concrete Products: www.basalite.com.
        b. Best Block McKinney Concrete Products, Inc. (Pueblo, CO)
        c. Valley Block Co. (Loveland, CO)
        d. Colorado Best Block: www.coloradobestblock.com.
        e. Approved substitute.

    3. Integral Colored Face Block:
        a. Baselite Concrete Products: www.basalite.com.
        b. Best Block McKinney Concrete Products, Inc. Pueblo, CO)
        c. Colorado Best Block: www.coloradobestblock.com.
        d. Approved substitute.

    4. Non-rated and Fire-rated glass unit masonry: Pittsburgh Glass Block Co. www.pittsburghglassblock.com, or approved substitute.
    5. Acoustical units: Standard size CMU with one (1) side slotted and core containing noncombustible fibrous sound-absorbing metal-backed batt material. "Soundblox" as manufactured by the Proudfoot Company, Inc. www.theproudfootcompany.com, or approved substitute.

END OF SECTION

DIVISION 05 - METALS

05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Load-bearing structural metal framing.

B. Referenced Standards/Minimum Criteria:
   1. Design, Detailing, Fabrication, and Erection: AISC "Specification for Structural Steel Buildings" and "Load and Resistance Factor Design Specification for Structural Steel Buildings", latest editions.
   2. AISC "Specifications for Architecturally Exposed Structural Steel", latest edition.
   3. AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", latest edition.
   4. AWS D1.1 "Structural Welding Code- Steel", latest edition.
   5. Steel Shapes, bars, and Plates: Conform to ASTM A992, ASTM A572, or A36.
   6. Standard Bolts and Nuts: Conform to ASTM A325.
   7. Slip-Critical High Strength Bolts and Nuts: Conform to ASTM A325.
   8. Anchor Bolts: Conform to ASTM A36.
   9. Steel Tubing: Steel tubing shall conform to ASTM AS00.
   10. Steel Pipe: Conform to ASTM A501, or ASTM A53.

C. Submittals Required:
   1. Shop drawings and calculations where required.
   2. Certificates:
      a. Mill Test Reports: Furnish for all structural steel supplied if requested by Architect. Furnish all mill test reports and load test results of each lot of high strength bolts if required by Architect.
      b. Welder Certificates: Furnish for all welding operations used for fabrication and erection.
   3. Product Data: Submit product data for load indicator bolts and slide bearing plates.
   4. Fabricator and Erector Qualifications: Submit prior to the submission of shop drawings.

D. Restrictions/Critical Criteria:
   1. Welder Qualifications: Welding shall be done by AWS certified welding operators only.
   2. Testing Agency: If directed by the Architect, weld tests will be made by an approved laboratory selected and paid for by the School District. Testing agency must be experienced in X-ray or ultrasonic testing of weld joints.

3. Fabricator and Erector Qualifications:
   a. Structural steel fabricated and erected under this Section, and Metal Fabrications, Open Web Steel Joists, Steel Deck, and Metal Stairs furnished and installed under related Sections shall be furnished and installed under the single subcontract responsibility of an approved structural steel fabricator. If the structural fabricator subcontracts the erection, the erection subcontractor must also meet the minimum qualifications prior to bidding.
   b. Fabricators and/or erectors for this project must demonstrate to the satisfaction of the School District the following qualifications in addition to any other requirements of the Project manual.
      1) Business longevity under current business name of five years or more immediately prior to bidding this project.
      2) Previous experience showing successfully completed projects of similar size and complexity as this project involving fabrication and erection of structural steel. Fabricators must show fabrication experience and erectors must show erection experience to be considered.

   c. Any change of steel fabricator/erector required as a result of failure to meet the above requirements shall be made at no additional cost to the School District.

4. Allowable Tolerances: Erect individual pieces so deviation from plumb, level, and alignment shall not exceed 1 in 500.
5. Shop paint all steel shapes per AISC standards and SSPC technical criteria. For structural steel on the exterior of buildings, use primer compatible with final field paint (example, Tnemec) and install per SSPC, SP6 technical guidelines.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Materials are unrestricted provided they meet specification requirements.

05 20 00 – STEEL JOIST FRAMING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Open web steel joists.
   2. Bridging and accessories.

B. References Standards/Minimum Criteria:
   1. Conform to latest edition of Standard Specifications of Steel Joist Institute (SJI) and AISC Specifications in materials, fabrication, design and erection.
   2. Welder Qualifications: Welding shall be done by AWS certified welding operators only.
   3. Manufacturer Qualifications: Joist manufacturer shall be a member of the Steel Joist Institute (SJI).

C. Submittals Required:
   1. Shop drawings.
   2. Design calculations for long-span joist field splices.

D. Restrictions/Critical Criteria:
   1. All components, fasteners, and hardware by single manufacturer.
   2. Field modification of joists prohibited.
   3. Camber: Camber at mid-span of adjacent deep long-span joist shall not vary more than 1-inch at mid-span at time of erection.
   4. Shop painting criteria same as for structural steel.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Materials are unrestricted provided they meet specification requirements.

05 30 00 – STEEL DECKING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Galvanized and painted finish steel decking.
   2. Corrugated metal forming.
   3. Floor deck.
   4. Roof deck.
   5. Composite floor deck.
   6. Acoustical roof deck.
      a. Include acoustical insulation to be provided by acoustical deck manufacturer and installed under applicable Division 07 – Roofing section.
   7. Filler plates, sump pans, and other accessories.

B. Referenced Standards/Minimum Criteria:
   1. Conform to AISI Specifications for the Design of Cold-Formed Steel Structural Members, latest edition.
   2. Welder Qualifications: Welding shall be done by AWS certified welding operators only.
   3. Approvals: Manufacturer's product must have I.C.B.O. approval.
   4. Galvanized Decking: Form decking with galvanized finish from steel sheets conforming to ASTM A611, Grades C or D; or conforming to ASTM A446, Grade A, C, or E. Galvanized finish shall conform to ASTM A525, G 60 light commercial coating.
   5. Painted Finish Decking: Form decking with painted finish from steel sheet conforming to ASTM A611, Grades C, D, or E; or conforming to ASTM A446, Grades A, B, C, D, E, or F.

C. Submittals Required:
   1. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Welding: By shielded arc process. Conform to American Welding Society Standards. Employ only skilled welding operators capable of meeting the qualifications of AWS Code and who have been certified by an approved testing laboratory.
   2. Deck units shall span over three (3) or more spans wherever possible.
   3. If Acoustical deck by EPIC Metals is used, specify whether it is factory or field painted.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Vulcraft Sales Corp. www.vulcraft.com.
   2. Verco Manufacturing, Inc. www.vercodeck.com.
   3. EPIC Metals Corp. www.epicmetals.com (for specialized acoustical roof deck).
   4. Approved Substitute.

05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Cold formed load-bearing metal studs and joists.

B. References Standards/Minimum Criteria:
   1. Conform to AISI Specification for the design of Cold-Formed Steel Structural Members, latest edition.
   2. Install framing in accordance with ASTM C1007.
   3. Welders shall be qualified in accordance with AWS D1.1 and AWD 1.3.
   4. Steel: Form from steel conforming to ASTM A570, Grade D, except that the minimum yield point shall be 50 ksi for 16 gauge and heavier.
   5. Bridging: Bridging may be either 18 gauge or heavier channel studs of the same nominal width as the studs, staggered not more than 16-inches; or continuous minimum 1-1/2-inch cold-rolled channels positioned through stud punch-outs. The ratio of unbraced length to least radius of gyration (I/r) of the bridging members shall not exceed 300. Channel stud bridging shall be formed from steel conforming to ASTM A611, Grade C. Continuous channels used for bridging shall conform to ASTM A645.
   6. Allowable tolerance: Maximum variation 1/8" in 10'-0".
   7. Provide deep leg top track and/or slip joint at top to allow for load deflection and/or slab movement.

C. Submittals Required:
   1. Shop drawings.
   2. Product Data.

D. Referenced Standards/Critical Criteria:
   1. All erection of framing to comply with manufacturer's approved methods. Framing may be prefabricated into panels at the Contractor's option. Space studs not more than 16-inches on center. Weld joints; screwed connections will not be allowed. Welding shall be done with AWS A5.1 or A5.5 E60XX electrodes.
   2. Splices in studs or joists are not permitted. Seat studs squarely in the track with the stud web and flanges abutting the track web, plumbed or aligned, and securely attach to flanges or web of upper and lower tracks by welding.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Structural Studs and Joists:
   1. Clark-Western Metal Lath Company: www.westsidebmc.com.
   2. Unimast, Inc. www.clarkdietrich.com.
   3. SCAFCO Steel Stud Company: www.scafco.com.
   4. ClarkDietrich Building Systems: www.clarkdietrich.com.
   5. MarinoWare: www.marinoware.com.
   6. Studco US: www.studcosystems.com.
   7. Approved substitute

05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

A. Summary - Section includes but is not limited to:
   1. Anchor bolts and weld plates for anchoring metal fabrications.
   2. Steel handrail brackets and handrails.
   3. Railing sleeves.
   4. Steel ladders.
   5. Steel railings and guardrails.
   6. Areaway gratings.
   7. Overhead rolling door supports.
   8. Foot scrapers.
   9. Folding panel partition supports.
   10. Exterior door stop supports.
   11. Exterior abrasive stair nosings.
   12. Unistrut grid and support system.
   13. Steel column covers.
   14. Auditorium stage ceiling grid and supports.
   15. Bollard posts.
   16. Auditorium catwalk caged wall ladder.
   17. Expansion joint supports.
   18. Frames around roof and floor openings.
   19. Steel angles, lintels, and columns at window and door openings.

20. Exterior and interior bench supports.
21. Steel base and threshold plates at Gymnasium.
22. Mechanical screen walls on roof.
23. Trench drain system.
24. Checkered plate.
25. Roof ladders.
26. Elevator pit ladder.
27. Perforated sheet metal.
28. All other miscellaneous angles, channels, tubes, and plates as indicated.

B. Referenced Standards/Minimum Criteria:
1. Steel: Conform to AISC "Specifications for Architecturally Exposed Structural Steel", latest edition.
2. Welding: Conform to "AWS Structural Welding Code".
3. Steel, Shapes, Bars, and Plates: Conform to ASTM A36.
4. Steel Pipe and Tubing: Conform to ASTM A53, A501, or A500.
5. Headed Anchor Studs: Conform to ASTM A108.
6. Reinforcing Steel Grade 60 Weldable: Conform to ASTM A706.
7. Shop Paint: Steel Structure Painting Council Specification. SSPC - Paint - 25 or Tnemec Series 10-99 Primer. See shop painting for structural steel for compatibility requirements.

C. Submittals Required:
1. Shop drawings.
2. Product data (stair nosings and trench drain system) as required.

D. Restrictions/Critical Criteria:
1. All cuts shall be clean and sharp with edges ground smooth. On completion, the work shall be straight, rigid and tight, and free from defects.
2. Close exposed ends of steel pipe, channel, or tubing with welded steel plate caps.
3. Comply with latest American Welding Society Standards. Miter and cope intersections and weld all around. Remove splatter and grind exposed welds to blend and contour surfaces to match those adjacent.
4. Provide OSHA compliant fixed steps or ladders at:
    a. Roof access hatches.
    b. Vertical offsets between roof levels that exceed 36-inches.
    c. Under crawl space access hatches.
    d. Auditorium catwalk access points. Provide ladder guards.
5. Auditorium catwalk wall ladders shall have removable access panel at bottom of cage.
6. Minimum tread dimension for steel ladders to be 2-1/2-inches x 3/8-inch. Treads shall be spaced no more than 12-inches on center.
7. "Ships Ladders" are not recommended.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Materials are unrestricted for steel shapes provided they meet specification requirements.
   2. Abrasive Stair Nosings: "Super-Grit Aluminum" by Wooster Products: www.woosterproducts.com, or similar "Special Purpose Treads, Type 138". Provide concealed fasteners.
   3. Areaway Gratings:
      a. Bearing bar and cross bar size and spacing shall be as required for span and size of opening. Grating shall be able to support uniform liveload of 120 psf. Provide 24-inch x 24-inch hinged access hatch with angle frame, grating cover, and padlock hasp. Secure grating to frame with saddle clips and self-drilling vandal proof fasteners.
      b. Provide manufactured galvanized steel bar gratings as manufactured/ supplied by
         1) Ohio Gratings, Inc. www.ohiogratings.com.
         2) Ametco Mfg. www.ametco.com.
         3) McNichols Company: www.mcnichols.com.
         4) Peterson Company: www.peterson-co.com.
         5) Approved substitute.

05 51 00 – METAL STAIRS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Pan tread, channel stringer stairs.
   2. Stringer and wall-mounted handrails.

B. Referenced Standards/Minimum Criteria:
   1. Steel: AISC Code of Standard Practice for Steel Buildings and Bridges, Architecturally Exposed Structural Steel.
   2. Welding: AWS D1.1 and D1.3 Structural Welding Code - Steel.
   3. Stairways: Standard construction details of "Metal Stairs Manual" of the National Association of Architectural Metal manufacturers, latest edition.

C. Submittals Required:
   1. Shop drawings.
   2. Color options for abrasive stair nosings.

D. Restrictions/Critical Criteria:
   1. Welder Qualifications: Welding shall be done by operators currently qualified according to AWS D1.1 and D1.3.

2. Shop Painting: Spray apply to uniform dry film thickness of 2.0-3.0 mils, free of runs, sags or other defects. Omit shop primer within 2-inches of field welded connections, compression joints surfaces, and steel embedded in concrete. Specify primer compatible with final field paint (example, Tnemec).
3. Pan Tread Channel Stringer Stairs:
    a. Design Criteria: Engineered by the fabricator to carry 100 psf uniform load.
    b. Stair Components: Stair runs and platform minimum dimensions per local code.
    c. Tread and Platform Pans: 10 gauge steel. 2.5 lb. minimum self-furring lath tack welded to pans immediately before concrete fill is placed.
    d. Risers: Closed type.
    e. Concrete Fill: Per Division 03 Section "Cast-in-place Concrete".
    f. Abrasive Stair Nosings: "Spectra Safety Tread", Type WP3JT by Wooster Products: www.woosterproducts.com, or similar substitute with blanked out sure hold anchor.
    g. Handrails: In compliance with local codes for structural performance and dimensions.

PART 2 - PRODUCTS

A. Acceptable Products/Materials:
    1. Materials are generally unrestricted provided they meet specification requirements.

END OF SECTION

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

A. Summary - Section Includes:
   1. Wood framing and blocking.
   2. Rough hardware.
   3. Plywood sheathing.

B. Referenced Standards/Minimum Criteria:
   1. Wood Framing: Comply with requirements of International Building Code and "National Design Specification for Wood Construction", latest edition, as published by National Forest Products Association.
   2. Lumber: Comply with Standard Grading Rules for Western Lumber, latest edition, published by Western Wood Products Association. Each piece of lumber shall be grade stamped.
   3. Plywood: Comply with U.S. Product Standard PS 1 for Softwood Plywood/Construction and Industrial. Each panel shall be identified with the grade trademark of the American Plywood Association.
   4. Treated Wood: Comply with Standards of the American Wood Protection Association (AWPA). Fire treatment per AWPA Standards U1 and T1. For preservative treatment, conform to AWPA Standard U1.

C. Submittals Required:
   1. Product data for fire retardant treated lumber and plywood.

D. Restrictions/Critical Criteria:
   1. Framing lumber and plywood sheathing on the interior of the building, not required to be preservative treated, shall be fire retardant treated, Class A Fire Rated with a flame spread of 25 or less.
   2. Framing lumber and plywood sheathing in contact with roof membrane or on the exterior of the building shall be pressure impregnated with fire retardant with a Class A fire rating.
   3. Framing: Framing for all portions of the work shall be performed in substantial manner consistent with accepted standards of the carpentry trade. Erect framing plumb, level and true, and rigidly anchor in place. Locate studs 16-inches on center except where indicated otherwise.
   4. Plywood Sheathing: Install sheathing panels with face grain across supports. End joints shall occur over supports with end joints staggered. Properly support plywood panels around cutouts and openings.

5. Install blocking or plywood in stud space behind gypsum board partitions for attachment of wall stops, cabinets, and other wall mounted accessories. Contractor shall verify mounting requirements of cabinets and accessories to ensure adequate blocking is provided within partitions.
6. Provide continuous fire-retardant treated 3/4-inch plywood or OSB continuous lumber blocking at all mounting locations including but not limited to:
    a. Handrails and guardrails
    b. Door stops
    c. Hold opens
    d. Grab bars
    e. Architectural specialties
    f. Plumbing fixtures
    g. Toilet accessories
    h. Luminaires (wall mounted)
    i. Surface mounted devices
    j. Casework and shelving (wall and base cabinets at the top of each unit)
    k. Industrial shelving
    l. Markerboards and tackboards
    m. Projection screens
        1) Indicate on the drawings the mounting heights for projection screen blocking.

    n. Wall-mounted door holders (magnetic and mechanical)
    o. Miscellaneous equipment
    p. All other surface-mounted items as required for proper anchorage
    q. Coordinate with the library furnishings planner and supplier (separate contract through CCSD) so that blocking is installed by the General Contractor for all shelving and custom casework provided under the Library Furnishings Contract.

PART 2 - PRODUCTS

A. Acceptable Products:
    1. Rough Hardware: Provide necessary bolts, screws, nails, clips, plates, straps, hangers, etc., required for the completion of rough carpentry. Hardware shall be correct material of proper size and strength for the purpose intended and shall conform to the requirements of all applicable building codes. Exterior hardware items embedded in concrete or masonry shall be galvanized. Anchor bolts indicated to be built into concrete for support of wood framing shall be provided under this Section and installed under Division 03 Sections "Concrete Formwork" and "Cast-in-place Concrete".
    2. Framing Lumber: (Non-Fire Rated)
        a. Studs: Hem-Fir, Stud Grade or Construction Grade.
        b. Plates: Hem-Fir, Standard Grade or better.
        c. Joists and Headers: Hem-Fir, No. 2 Grade or better.
        d. Blocking and Furring: Hem-Fir, Standard Grade or better.
        e. Roof and Wall Plywood Sheathing: Exterior sheathing with exterior glue.
        f. Equipment mounting boards, B-C Grade.

3. Framing Lumber and Plywood (Fire Rated)
   a. "Exterior Fire-X" by Hoover Treated Wood Products: www.frtw.com.
   b. Approved substitute.

4. Interior framing lumber and plywood (Fire Rated):
   a. "Pyro-Guard" by Hoover Treated Wood Products: www.frtw.com.
   b. "DRICON" by Lonza Wood Protection: www.wolmanizedwood.com.
   c. "FlamePro Fire Retardant Treated Wood" by Koppers Performance Chemicals: www.koppersperformancechemicals.com.

06 20 00 – INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

A. Summary - Section Includes:
   1. Millwork items including but not limited to interior wood trim.

B. Referenced Standards/Minimum Criteria:
   1. Conform to the requirements of "Architectural Woodwork Standards", latest edition, as published by the Architectural Woodwork Institute: www.awinet.org.
   2. Conform to requirements of the National Particleboard Association (NPA): www.compositepanel.org.

C. Submittals Required:
   1. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Trim materials shall be free of all defects to the extent required by AWI Custom Grade, allowanced for the species used.
   2. Wherever possible, each length of finish trim shall be in single piece. No butt joints will be allowed except for long pieces which may be in two or more sections.
   3. Install trim level, plumb and true, and tightly secure to backing with nails, screws, or glue. Blind nail wherever possible. Where surface nailing is necessary, use finish nails.

PART 2 - PRODUCTS

A. Acceptable Materials:
   1. Interior Trim: Painted: Select kiln-dried sugar pine or Idaho white pine.
   2. Interior Trim: Painted: Select kiln-dried red or white birch.
   3. Interior Trim: Natural Finish: Select kiln-dried straight grain clear red oak or white birch.

06 40 00 – ARCHITECTURAL WOODWORK

PART 1 - GENERAL

A. Summary - Section Includes:
   1. Custom cabinets and countertops (usually lavatory counters, library circulation desk, etc.).
   2. Shelving.
   3. Windowsills.
   4. Display cases.
   5. Coat boxes at elementary schools.

B. Referenced Standards/Minimum Criteria:
   1. Architectural Woodwork Institute (AWI) "Architectural Woodwork Standards," latest edition.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Color options (full range) for plastic laminate and PVC edging.

D. Restrictions/Critical Criteria:
   1. Use 3 mm PVC edging for door and drawer front edges and front edge of windowsills.
   2. Use 3 mm PVC edging for all front and backsplash edges of countertops.
   3. Use 1mm PVC edging for cabinet body edges and coat-box edges.
   4. All countertops 1.125-inch thick medium density particleboard - with 0.050-inch plastic laminate top and backer sheet on underside of countertop.
   5. Maximum span for wood or plastic laminate covered shelves is 36-inches between shelf standards.
   6. Provide locks on all drawers and doors. Verify extent of locks on cabinet doors in elementary schools with School District.

PART 2 - PRODUCTS

A. Acceptable Plastic Laminate Manufacturers:
   1. Formica: www.formica.com.
   2. Wilsonart: www.wilsonart.com.
   3. Nevamar: www.nevamar.com.
   4. Laminart: www.laminart.com.
   5. Approved substitute.

B. Acceptable Trim Materials:
   1. Pine: Select kiln-dried sugar pine or Idaho white pine, C Select or better.
   2. Birch: Select kiln-dried or white birch.
   3. Red Oak: Select kiln-dried straight grain clear red oak.

C. Acceptable Plywood Materials:
   1. Premium Grade plain sliced red oak or white birch with face veneers per HPVA Grade A.

D. Acceptable Materials - Plastic Laminate Faced Casework:
   1. Exposed Surfaces (including inside surfaces of open shelving units): Vertical Grade, High Pressure Decorative Laminate 0.030-inch thick.
   2. Semi-Exposed (backs of doors and inside surfaces of cabinets with doors): Melamine Laminate, 0.020-inches thick. Cabinet liner type. Painted surfaces not acceptable.
   3. Concealed Surfaces: Melamine Laminate, 0.020-inch thick, liner or backer type.

E. Hardware:
   1. Use same hardware as specified in Division 12 Section "Plastic Laminate Faced Casework".

06 66 40 – SOLID SURFACING MATERIAL FABRICATIONS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Solid surface material countertops and windowsills.

B. Referenced Standards/Minimum Criteria:
   1. ASTM D 256-18 "Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics".
   2. ASTM D570-18 "Standard Test Method for Water Absorption of Plastics".
   3. ASTM D638-14 "Standard Test Method for Tensile Properties of Plastics".
   4. ASTM D696-16 "Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C with a Vitreous Silica Dilatometer".
   5. ASTM D790-17 "Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials".
   6. ASTM D1499-13 "Standard Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics".
   7. ASTM D5420-16 "Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact) ".
   8. ASTM E84-20 "Standard Test Method for Surface Burning Characteristics of Building Materials".
   9. ASTM G21-15 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi".

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Samples for color selection.

D. Restrictions/Critical Criteria:
   1. Solid Polymer Material: Homogeneous filled acrylic meeting ANSI Z124.3 and Z124.6, Type Six, and FS WW-P-541E/GEN (1); not coated, laminated, or of composite construction.
   2. Surface Burning Characteristics: Flame spread index of 25, smoke developed index of 30; when tested in accordance with ASTM E 84 (Class I).
   3. Countertops: Horizontal surfaces of solid polymer material, minimum 1/2-inch (3 cm) with built-up edge to 1-1/2-inch thickness; adhesively joined with inconspicuous seams.
      a. Colors: As selected from manufacturer's full range.
      b. Indicate edge and corner detail.

   4. Windowsills: Horizontal surfaces of solid polymer material, minimum 1/2-inch with built-up edge to 1-inch thickness; adhesively joined with inconspicuous seams.
      a. Colors: As selected from manufacturer's full range.
      b. Indicate edge and corner detail.

   5. Finish: Uniform on all surfaces.
      a. Matte: Gloss rating of 5-20.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Hi-Macs" as manufactured by LG Hausys: www.lghimacusa.com.
   2. Avonite Surfaces: www.avonitesurfaces.com.
   3. DuPont Corp. www.corian.com.
   4. Formica Solid Surfacing: www.formica.com.

END OF SECTION

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 11 13 – BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Bituminous Dampproofing - Use at external side of crawl space foundation walls from bottom of foundation to top of grade beam, if exterior earth grade is at same elevation as top of grade beam.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittal Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Materials to be EPA VOC compliant.
   2. Maintain substrate temperature as per manufacturer's recommendation.
   3. Application shall be by a factory authorized applicator.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Fibered Dampproofing" by Karnak Corp. www.karnakcorp.com, for installation by brush, roller, or spray.
   2. Approved substitute.

07 13 26 – SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Self-adhering sheet membrane waterproofing
   2. Note: Either fluid-applied or sheet membrane waterproofing may be used on outside of exterior foundation walls and elevator pit walls where finish grade is above the interior floor line at occupied or usable spaces.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Installers must be approved / trained by manufacturer.

PART 2 - PRODUCTS

A. Acceptable Manufacturers and Systems - Sheet Membrane Waterproofing:
   1. "PW-100/60" by Protecto Wrap: www.protectowrap.com.
   2. "Bituthene Post-applied Waterproofing" by GCP Applied Technologies: www.gcpat.com.
   3. "Miradri 860/861 Sheet Membrane Waterproofing System" by Carlisle Coatings and Waterproofing: www.carlisleccw.com.
   4. Approved substitute.

07 14 00 – FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Fluid applied waterproofing.
   2. Note: Either fluid-applied or sheet membrane waterproofing may be used on outside of exterior foundation walls and elevator pit walls where finish grade is above the interior floor line at occupied or usable spaces.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Materials are to be EPA VOC compliant.
   2. Maintain substrate temperature at minimum of 55 degrees F during installation.
   3. Applicator Qualifications: Application shall be by a factory authorized applicator. Work shall be supervised by an authorized manufacturer's representative who shall be on the job site during application.
   4. Concrete surfaces are required to be properly cured (per manufacturers requirements) prior to installation of waterproofing materials.

PART 2 - PRODUCTS

A. Acceptable Manufacturers and Systems - Fluid-Applied Waterproofing:
   1. "TREMproof 260" by Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.
   2. Carlisle "CCW – 525" by Carlisle Coatings & Waterproofing: www.carlisleccw.com.
   3. Approved substitute.

B. Protection Board: Per waterproofing manufacturer's recommendations.

07 18 00 – EQUIPMENT ROOM DECK COATING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Coating on floors and curbs of mechanical rooms located above occupied spaces.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Color samples.

D. Restrictions/Critical Criteria:
   1. Concrete must be cured minimum of 28 days prior to application.
   2. Apply two (2) coat system per manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Vulkem 350/351" by Tremco Sealants: www.tremcosealants.com.
   2. Approved substitute.

07 19 00 – WATER REPELLENT ANTI-GRAFFITI COATINGS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Water repellent anti-graffiti coating on exterior masonry walls.
   2. Graffiti control coating on interior masonry walls in building.
   3. Materials for graffiti removal.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Warranty documents.

D. Restrictions/Critical Criteria:
   1. Mock-Up: Apply coatings to masonry sample panel. Obtain Architect's approval before proceeding.
   2. Coating systems shall not be applied until masonry has been thoroughly cleaned and is dry and free of efflorescence.
   3. Graffiti Control Coating: Masonry shall be clean and dry to the satisfaction of the Architect. Apply graffiti control coating from grade up to full height of walls on entire perimeter of building at coverage rate as recommended by manufacturer.
   4. Protect adjacent surfaces from overspray. Mask windows with protective sheeting prior to coating applications.
   5. Warranty: Replace materials that fail to provide water repellency for a period of 5-years after substantial completion, including both material and labor to install material.

PART 2 - PRODUCTS

A. Acceptable Manufacturer/Products - Water Repellent/Anti-Graffiti Coating:
   1. "Protectosil Antigraffiti" by Evonik Industries: www.evonik.com.
   2. "Sure Klean Weather Seal Blok-Guard and Graffiti Control" by Prosoco: www.prosoco.com.
   3. "Graffiti Gard S" by Textured Coatings of America: www.texcote.com.
   4. Approved substitute.

B. Graffiti Removal Solution (provide 1 gallon)
   1. "Graffiti Wipe" by Prosoco: www.prosoco.com.
   2. Approved substitute.

07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

A. Summary - Section includes:
   1. Rigid insulation.
   2. Blanket insulation.
   3. Foamed insulation.

B. Referenced Standards/Minimum Criteria:
   1. Minimum insulation values for walls and roofs shall be as defined in the International Energy Code.
   2. Net minimum insulation design goals (average for entire assemblies):
      a. Roof system: R20 (equivalent to about 3-inches of rigid insulation or 6-inches of batt insulation).
      b. Wall system: R19 (equivalent to about 6-inches of batt insulation).
      c. Slab on grade (perimeter}: R12 (equivalent to about 2-inches of rigid insulation}.

   3. Use full thickness of blanket insulation to fit stud with (i.e., 6-inch batts for 6-inch stud).

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. All batt/blanket insulation exposed in return air plenums shall be foil faced with flame spread of 25 or less on plenum side of insulation.
   2. In order to avoid sagging of insulation in steel studs tape batt flanges to face of steel studs.
   3. Install insulation types per manufacturer's recommendations.
   4. Foamed in place insulation may be used in lieu of batt insulation in stud space and/or cavity between exterior sheathing and masonry.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products - Rigid Insulation:
   1. "Styrofoam Brand XPS Insulation" by DuPont: www.dupont.com.
   2. "Foamular 250" by Owens-Corning: www.owenscorning.com.
   3. R-Max: www.rmax.com.
   4. Approved substitute.

B. Acceptable Manufacturers/Products - Blanket Insulation:
   1. Owens Corning Fiberglass: www.owenscorning.com.
   2. Johns-Manville: www.jm.com.
   3. Certainteed Corp. www.certainteed.com.
   4. Approved substitute.

C. Acceptable Manufacturers/Products - Foamed Insulation:
   1. "Walltite" by BASF Spray Polyurethane Foam: www.spf.basf.com.
   2. "Thermco Foam" for block fill: www.thermcofoam.com.
   3. Approved substitute.

07 24 00 – EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 - GENERAL

A. Summary - Section includes:
   1. The use of EIFS is not permitted on CCSD projects.

07 26 16 – UNDERSLAB VAPOR RETARDERS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Underslab vapor retarders
   2. Crawlspace vapor retarders
   3. Seam tape

B. References Standards/Minimum Criteria:
   1. Vapor barrier: ASTM E-1745-08

C. Submittals Required:
   1. Product data for vapor barrier.

D. Restrictions/Critical Criteria:
   1. Include underslab vapor barrier and underslab gravel bed when recommended by the Geotechnical Engineer. Design according to Geotechnical Engineer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Products - Underslab Vapor Retarder:
   1. "StegoWrap" 15 mil, Stego Industries: www.stegoindustries.com.
   2. "Perminator" or "Perminator HP" 15 mil, W.R. Meadows: www.wrmeadows.com.
   3. Approved Substitute.

B. Acceptable Products - Crawlspace Vapor Retarder:
   1. "StegoCrawl" 15 mil, Stego Industries: www.stegoindustries.com.
   2. Approved Substitute.

07 53 23 – EPDM MEMBRANE ROOFING -LOOSE-LAID BALLASTED OR FULLY ADHERED

PART 1 - GENERAL

A. Summary - Section includes:
   1. Loose-laid ballasted EPDM roofing or fully-adhered EPDM membrane roofing.
   2. Roof insulation.
   3. Base flashings.
   4. Bonding adhesives, lap sealants, fasteners, and other accessories.
   5. Walkway pavers and pads.
   6. Insulation cover board.
   7. Gypsum board base as required for fireproofing.

B. References Standards/Minimum Criteria:
   1. UL Class A external fire rating, conform to IBC requirements for "high wind," exposure "C".
   2. Qualifications: Roofing applicator shall be approved by membrane manufacturer and shall be a firm having successfully installed roofing of type specified for a minimum of five (5) years.
   3. Roofing system is to have a 20-year life expectancy.
   4. Insulation in roof system per ASTM E119 and ASTM E84.
   5. Ballast per ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Sample warranty.
   4. Samples of membrane.

D. Quality Control Submittals by Contractor:
   1. Manufacturer's Field Reports: Submit written report from manufacturer's representative after inspection of roof deck to verify deck is satisfactorily for installation of system. Submit additional report indicating roof has been installed in accordance with manufacturer's requirements.
   2. Record of Work: Submit written records indicating temperature and moisture conditions and the type of and location or work being done during each day of roofing operations.
   3. Wind Uplift Report: Submit copy of IBC Report for roofing to be installed, indicating roofing system has been tested and approved for wind uplift requirements specified.
   4. Certification: Submit written certificate that applicator is approved by roofing manufacturer.

E. Restrictions/Critical Criteria:
   1. Design consultant to specify/design roof systems to provide for structural/thermal movement, wind loadings/uplift, and periodic foot traffic without failure. Confirm with Owner type of roof to be used.

2. Drainage Issues:
   a. Slope roof structure (where possible) to achieve 1/4-inch per foot roof slope as required by the IBC. Where sloping of structures is not possible and where crickets are required use tapered insulation.
   b. Install crickets or saddles to allow immediate drainage away membrane flashing and to direct water to roof drains/leader heads.
   c. The use of roof drains with interior storm piping is preferred over exterior drainage/downspouts.
   d. Maintain a minimum of 18-inch separation between penetrations, roof drains, curbs, and changes of levels.
   e. Termination of base flashings to be 8-inch minimum above the highest point of roof membrane.
   f. Curbs supporting rooftop equipment shall be a minimum of 12-inches in height.
   g. Provide overflow drains/scuppers as required by IBC.

3. Design access to each major roof level from walkout doors or roof hatches. Access to minor roof areas may be by means of steel ladders when the height difference is greater than 3-feet.
4. The roof system manufacturer's regional representative shall be required to inspect the work a minimum of once per week during installation of the roof and submit inspection report to Contractor, who will submit copies to the Architect.
5. An inspector of the roof system manufacturer shall make an inspection upon completion to ascertain that the entire system has been installed according to manufacturer's published specifications and details.
6. Install roofing system and accessories per manufacturer's recommendations.
7. Where required for fire rating of roof assembly install gypsum sheathing on top of metal deck and under rigid insulation. Fasten per roofing system manufacturer's recommendations.
8. Warranties:
   a. Provide manufacturer's non-pro-rated, initial dollar limit warranty against defects in materials and workmanship in roof system including membrane, insulation, fasteners, and base flashings for a period of ten (10) years from completion of roof.
   b. Provide roofing installer's two (2) year warranty against defects in material and workmanship of roofing system.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products – Loose-laid, Mechanically Fastened Ballasted EPDM Roof System:
   1. Ballasted System, Design B; 60 mil with 60 mil flashings, color black by Carlisle SynTec: www.carlislesyntec.com, or comparable system by one of the following:
      a. Firestone: www.firestonebpco.com.
      b. Verisco, Inc. www.versico.com.
      c. Genflex: www.genflex.com.
      d. Johns Manville: www.jm.com.
      e. Approved substitute.

B. Acceptable Manufacturers/Products – Fully Adhered EPDM Roof System:
   1. Fully adhered EPDM Roofing System; 60 mil with 60 mil flashings, color black by Carlisle SynTec: www.carlislesyntec.com, or comparable system by one of the following.
      a. "Rubbergard" by Firestone: www.firestonebpco.com.
      b. Approved substitute.

C. As an alternate or option to using the adhered EPDM system the School District may consider using a 60 mil TPO adhered system such a "Sure-Weld TPO System" by Carlisle SynTec: www.carlislesyntec.com. White color.

D. Acceptable Roof Insulation:
   1. On Metal Deck: Two (2) layers of FS HH-1 1972/2 Class 1, polyisocyanurate rigid insulation with glass reinforced scrim racers. Total thickness, as required for R=20. Provide insulation of manufacturer and type approved by roofing membrane manufacturer.
   2. Tapered Insulation: FS HH-1-1972/2, Class 1, factory tapered polyisocyanurate rigid insulation, 1.5 pct minimum density. Tapered insulation system shall develop consistent surface slope of 1/4-inch per foot.
      a. Tapered Insulation Adhesive: Approved by insulation manufacturer.
   3. Insulation Fasteners for Adhered Roofing System: Carlisle "SureSeal HP Fasteners" or approved substitute, subject to acceptance by roofing manufacturer. Provide fasteners fully coated with manufacturer's standard fluoropolymer paint, of length required to penetrate deck 1/2-inch minimum. Pull-out resistance, 360 lbs. Minimum.
   4. Cover Board for Adhered Roofing System: Provide cover board as required by roofing manufacturer for use with fully adhered single ply membrane system and acceptable for required fire rating.
   5. Substrate Board: Gypsum based, provide as required to comply with required fireproofing assembly.

E. Acceptable Ballast for Ballasted EPDM Roof:
   1. Field of roof: Nominal 1" to 2" rounded water worn gravel at 12 lbs per square foot.
   2. Roof corners: Nominal 2" to 3" rounded water worn gravel at 18 lbs. per square foot.
   3. Roof perimeter: Nominal 2" to 3" rounded water worn gravel at 15 lbs. per square foot.

F. Acceptable Walkway Pavers:
   1. The Roofblok System: www.roofblok.com.
   2. Westile: www.westile.com.
   3. Approved substitute.
   4. Size: 12- x 16-inches, 12- x 12-inches, or 24- x 24-inches. Weight: 12 lbs. per square foot
   5. Installation: On paver protection pads as recommended by roof membrane manufacturer.

07 61 00 - SHEET METAL ROOFING AND SIDING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Standing seam roofing and standing seam or flat seam siding.
   2. Rake and eave fascia.
   3. Wall corners and specialty terminations.
   4. Ice and water dam shield.
   5. Other related flashing, closures, and terminations.

B. Referenced Standards/Minimum Criteria:
   1. Installer Qualifications: Installation only by Contractor/Erector approved and authorized by manufacturer with a minimum of 5 years of experience with similar installations.
   2. Design Criteria:
      a. Wind Speed and Exposure Classification: Metal roofing system shall be designed to withstand ground wind in accordance with the IBC.
      b. Fastening Details and Spacings: Designed by system manufacturer to meet specified wind speed criteria and snow sliding/accumulation structural requirements. Roof fasteners shall be designed to pass through insulation/sheathing substrate and be anchored through the structural metal roof deck into framing members where possible, and into the structural metal roof deck only where framing members are available.
      c. Attachment system shall be designed to provide movement capability to accommodate sheet metal roofing system thermal expansion and resist air infiltration.

C. Submittals Required:
   1. Shop drawings: Prepared by manufacturer or authorized representative of manufacturer.
   2. Manufacturer's product data.
   3. Design calculations: Compliance with wind speed criteria including test results of anchorage methods, roof pressure zones, and thermal movement calculations, all signed by registered Engineer.
   4. Color options: Actual samples of prefinished metal.
   5. Sample of manufacturer's twenty (20) year warranty that prefinished metal will not fade, chalk or crack and that the system will be watertight for the same 20 year period.

D. Restrictions/Critical Criteria:
   1. Sheet metal work shall be warranted, in writing, against defect in material and workmanship for a period of two (2) years from date of substantial completion.
   2. Watertight System: Metal roofing and siding shall provide non-pro-rated, initial dollar limit, twenty (20) year system watertightness warranty to cover the entire installation. The system manufacturer shall verify and approve all system components and details, review shop drawing submittals, and inspect installation prior to and following system installation. Warranty shall include all roofing penetrations, valley and eave conditions,

and roof mounted equipment installation. Roofing system manufacturer shall be responsible for all repairs due to defects in materials and/or workmanship in entire system as required to maintain roof and flashings in watertight condition following completion of installing roofing contractor's two (2) year warranty period through the remaining balance of the twenty (20) year period following the roofing completion date.

3. Install full width of ice and water shield at eaves and valleys of sheet metal roofing.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products - Prefinished Metal Roofing and Siding:
   1. Standing Seam or Flush Seam Panel Systems (24 gauge conforming to ASTM A792 and ASTM A250), flashings and fasteners. Prefinished metal to have Kynar Resin Fluoropolymer finish. Products as manufactured by one of the following:
      a. AEP-Span: www.aepspan.com
      b. Berridge Manufacturing Co.: www.berridge.com.
      c. Englert: www.englertinc.com.
      d. Ultra Seam, Inc. www.ultraseam.com.
      e. Approved substitute.

B. Acceptable Manufactures/Products - Accessories:
   1. Ice and Water Damming Shield: Self-adhering rubberized asphalt waterproofing membrane, 36-inch wide rolls, 40 mils thick, Class A rated, as manufactured by one of the following:
      a. GCP Applied Technologies: www.gcpat.com.
      b. Protecto Wrap: www.protectowrap.com.
      c. Owens-Corning: www.owenscorning.com.

   2. Joint Sealant: Approved type of polyurethane sealant, in accordance with requirements of roofing/siding manufacturer. Roofer's mastic is not allowed.
   3. Snow Guards: As recommended by manufacturer of roofing system.

07 60 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

A. Summary - Section includes:
   1. Wall caps and gravel stops.
   2. Flashing, counter flashing, reglet flashing.
   3. Overflow scuppers.
   4. Roof expansion joint covers.
   5. Scuppers, conductor heads, downspouts, and splash pans.
   6. Mechanical rooftop unit curb flashing.
   7. Other sheet metal flashing related to the above.

B. Referenced Standards/Critical Criteria:
   1. Comply with standards/recommendations of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Architectural Sheet Metal Manual, current edition.
   2. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting design pressures applicable per site location.
   3. Prefinished Sheet Metal: Conform to ASTM A792 - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Color options.
   4. Warranty documents.

D. Restrictions/Critical Criteria:
   1. Contractor Qualifications: Sheet metal shall be installed only by a firm specializing in sheet metal work and which has been in the sheet metal business continuously for the past five (5) years.
   2. Sheet Metal: Sheet metal work shall be warranted, in writing, against defects in materials and workmanship for a period of two (2 years) from the roof completion date.
   3. Contractor to construct all joints watertight and with provisions to allow for expansion using details and recommendations of manufacturers and SMACNA.
   4. Coat dissimilar materials in contact with each other with asphaltic compound.
   5. Counter Flashing: Furnish and install receiver and insert flashing. Construct two-piece system of galvanized iron or prefinished metal designed and installed to spring tight against base flashing.
   6. Manufacturer's twenty (20) year warranty that prefinished metal will not fade, chalk, or crack.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products - Prefinished Metal Exposed to View:
   1. 24-gauge Galvalume with Kynar Fluoropolymer Finish:
      a. Berridge: www.berridge.com.
      b. AEP-Span: www.aepspan.com.
      c. Centria Architectural Systems: www.centria.com.
      d. Approved substitute.

B. Acceptable Manufacturers/Products - Galvanized Iron at locations concealed from view:
   1. 20 gauge, hot-dipped, conforming to ASTM A36.
      a. Berridge: www.berridge.com.
      b. AEP-Span: www.aepspan.com.
      c. Centria Architectural Systems: www.centria.com.
      d. Approved substitute.

C. Acceptable Manufacturer/Products - Flexible EPDM Bellows Expansion Joint Cover with two metal flanges. Provide prefabricated intersections and corners:
   1. "Expand-O-Flash" by Johns Manville: www.jm.com.
   2. "Roof Expansion Joint" by Lexcor: www.lexcor.net.
   3. "Metalastic CMF Style" by GAF Materials: www.gaf.com.
   4. Approved substitute

07 72 00 – ROOF ACCESSORIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Smoke vents for auditorium stages.
   2. Roof access hatches.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Install products according to manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Manufacturer/Products - Smoke Vents:
   1. Type: Double-leaf Automatic Smoke Vent, size as required by Code, by one of the following:
      a. Bilco: www.bilco.com.
      b. Babcock Davis: www.babcockdavis.com.
      c. Milcor, Inc. www.milcorinc.com.
      d. Approved substitute.

B. Acceptable Manufacturers/Products - Roof Access Hatches:
   1. Type: Roof Hatch for vertical ladder access, minimum size 36-inches by 36-inches, by one of the following:
      a. Bilco: www.bilco.com.
      b. Babcock Davis: www.babcockdavis.com.
      c. Milcor, Inc. www.milcorinc.com.
      d. J.L. Industries: www.activarcpg.com/jl-industries.
      e. Nystrom: www.nystrom.com.
      f. Dur-Red Products: www.dur-red.com.
      g. Approved substitute.

C. Accessories:
1. Provide "Ladder-up Safety Post" by Bilco or equivalent by other manufacturer.
2. Approved substitute.

07 81 00 – CEMENTITIOUS FIREPROOFING

PART 1 - GENERAL

A. Summary - Section includes:
1. Sprayed-on fireproofing on structural steel members.

B. Referenced Standards/Minimum Criteria:
1. Regulatory Requirements: The sprayed-on fireproofing shall be tested by Underwriters Laboratories, Inc., (UL) or other certified testing agency to achieve fire resistive ratings required in accordance with ASTM E119 and ASTM E84 (smoke = 0, flame = 0, fuel = 0).
2. Fireproofing shall not contain asbestos fiber. Comply with requirements of the IBC, latest edition.
3. Minimum bond strength of fireproofing per ASTM E736 - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members: 200 psf.
4. Compressive strength of fire proofing per ASTM E761 - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members: 5.21 PCF.

C. Submittals Required:
1. Products data.
2. Certification: Submit certification that material is asbestos free and complies with local regulations for controlling VOC's.

D. Restrictions/Critical Criteria:
1. General: Apply sprayed fireproofing with experienced craftsmen in accordance with the manufacturer's recommendations in thickness required for fire rating.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
1. "CAFCO 400" by Isolatek International Corp. www.isolatek.com.
2. "Monokote Mk-6 HY" by GCP Applied Technologies: www.gcpat.com
3. Approved substitute

07 84 00 – FIRESTOPPING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Fire stop and smoke/draft barrier systems for penetrations through fire rated walls, ceilings, and floors.
   2. Construction gap barrier at top of walls, perimeter of fire rated hollow metal door frames, perimeter of fire rated floors, and similar.

B. Referenced Standards/Minimum Criteria:
   1. Products required under this Section shall comply with ASTM E119, ASTM E814 and the International Building Code, latest edition.

C. Submittals Required:
   1. Product data.
   2. Qualifications: Submit documentation from manufacturer verifying that installer is approved for installation of products and systems to be used.
   3. Certificate that materials are VOC compliant.
   4. Provide firestop penetration schedule showing typical penetrations of each material type for each construction assembly and the related fire resistive rating requirements for each type of construction assembly.

D. Restrictions/Critical Criteria:
   1. Install fire stop systems using methods and equipment in accordance with manufacturer's written instructions and the fire resistance listing.
   2. Fire stopping compounds shall be paintable or capable of receiving finish materials in areas which are exposed to view and scheduled to receive finishes.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products/Systems:
   1. USG: www.usg.com.
   2. Rectorseal: www.rectorseal.com.
   3. Tremco: www.tremcosealants.com.
   4. Specified Technologies, Inc. www.stifirestop.com.
   5. 3M Fire Protection Products: www.3m.com.
   6. Dow Inc. www.dow.com.
   7. Carboline Co. www.carboline.com.
   8. Hilti: www.hilti.com.
   9. Approved substitute.

07 91 10 – COMPRESSION SEALS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Rubber compression seals at expansion joints.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Color options/samples.

D. Restrictions/Critical Criteria:
   1. Install according to manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Expansion Compression Seals:
   1. Watson Bowman Acme: www.wabacorp.com.
   2. C-S Group: www.c-sgroup.com.
   3. MM Systems Corporation: www.mmsystemscorp.com.
   4. Approved substitute.

B. Manufacturer and Type: Watson Bowman "WABO Weatherseal II" or equal product of other acceptable manufacturer. Preformed thermoplastic rubber compound. Provide manufacturer's recommended lubricant adhesive. No field splices are allowed within exposed vertical joints. Provide size as required for joint width indicated.

C. Fire Rated Compression Seals: Provide UL listed or Warnock-Hersey labeled compression seal assemblies at fire-rated joints indicated on drawings. Provide manufacturer's fire resistive barrier behind compression seals as required to achieve required fire-rating.

07 92 00 - JOINT SEALERS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Caulking and sealant to seal against infiltration from air and water, and to provide a visual finish to seal cracks between dissimilar materials.
   2. Sealant backing materials.
   3. Bond breaker tape.

B. References Standards/Minimum Criteria:
   1. Joint sealant assemblies in fire-resistive construction shall be listed or classified for fire (F) and temperature (T) rating required by independent testing agency such as Underwriters Laboratories, Inc. (UL) or other agency acceptable to local building authority.
   2. Applicator Qualifications: Joint sealers shall be applied by a qualified sealant contractor in business for at least five (5) years prior to this installation, employing skilled tradesmen for the work.

C. Submittals Required:
   1. Product data.
   2. Color options.
   3. Furnish a two (2) year warranty in writing to replace joint sealant which fails during the warranty period to perform as air-tight and watertight joints; or which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability.

D. Restrictions/Critical Criteria:
   1. Install caulking and sealants per manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Non-rated Joint Backing Material:
   1. Non-Fire-Rated: Size joint backing material for minimum 30% compression when inserted in the joint. Material shall be round rod or semi-circular type.
   2. Acceptable Manufacturers and Type:
      a. "Ethafoam" by Richelieu: www.richelieu.com.
      b. "SOF Rod", "HBR", "HBR XL", or "OCFoam"" by Nomaco: www.nomaco.com.
      c. "Denver Foam" by Backer Rod Mfg, Inc. www.backerrod.com.
      d. Approved substitute.

B. Acceptable Fire-rated Baking Material:
   1. Joint backing material required by sealant manufacturer for UL listed joint assembly achieving required fire-resistive rating.
   2. Acceptable manufacturers and type:
      a. "Ultra-Block" by Backer Rod Mfg, Inc. www.backerrod.com.
      b. Approved substitute

C. Acceptable Manufacturers - Joint Sealants:
   1. Acceptable Manufacturers:
      a. DAP Inc. www.dap.com.
      b. GCP Applied Technologies: www.gcpat.com.
      c. Pecora Corporation: www.pecora.com.
      d. Tremco Manufacturing Company: www.tremcosealants.com.
      e. Sika Corporation: www.usa.sika.com.
      f. Bostik: www.bostik.com.
      g. Approved substitute

   2. Acceptable Materials:
      a. Primer: As recommended by the sealant manufacturer.
      b. Interior Sealants: Latex acrylic.
      c. Under Thresholds: Silicone.
      d. Plumbing Fixtures and Wet Areas: Kitchen and Bath specific silicone.
      e. Interior Fire-Rated Joint Sealant: One or two-component acrylic, silicone, or polyurethane having UL listing. Joint sealants for walls and ceilings shall be paintable.
      f. Control Joints and Expansion Joints in Interior Floor Slabs, Exterior Sidewalks, and Slabs on Grade: Two-component pourable self-leveling polyurethane.
      g. All Remaining Joint Sealants: Two-component polyurethane, Type 11, Class A, nonsag.

D. Acceptable Bond Breaker Tape:
   1. Polyethylene tape or other plastic tape as recommended by the sealant manufacturer to be applied to sealant-contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape wherever applicable.

07 95 00 – EXPANSION CONTROL

PART 1 - GENERAL

A. Summary - Section includes:
   1. Ceiling expansion joint covers.
   2. Floor expansion joint covers.
   3. Wall/floor expansion joint covers.

B. Referenced Standards/Minimum Criteria:
   1. Provide UL listed Warnock - Hersey labeled expansion joint cover assemblies at fire rated wall locations. Provide manufacturers fire resistive barrier behind joint covers as required to achieve fire-rating.

C. Submittals Required:
   1. Product data, including colors of elastomeric seal.

D. Restrictions/Critical Criteria:
   1. Install surface mounted expansion joint covers flush with adjacent finish in accordance with manufacturer's installation instructions. Corners shall be mitered.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. MM Systems Corporation: www.mmsystemscorp.com.
   2. Watson Bowman Acme: www.wabacorp.com.
   3. Balco: www.balcousa.com.
   4. Architectural Art Manufacturing, Inc. www.archart.com.
   5. C-S Group: www.c-sgroup.com.
   6. Approved substitute

B. Acceptable Products (Architect to verify these products are appropriate for specific design/location. Provide width appropriate for joint design):
   1. Ceiling Expansion Joint Covers: Low profile expansion joint system consisting of extruded 6063-T5 aluminum rails and flexible extruded polyvinyl chloride seals, designed to accommodate new or existing construction, which incorporates a colorable elastomeric seal that demonstrates ability to remain flat during normal movement cycles. Provide a complete system. Watson Bowman Acme "Model CEB" or equal product from other acceptable manufacturer.
   2. Floor to Floor Expansion Joint Covers: Mill-finish aluminum floor cover, recessed 1/8-inch for finish flooring materials. Provide manufacturer's recommended lubricant, adhesive, and expansion anchors. Watson Bowman Acme "Model FJG", "Model FJX" or equal product from other acceptable manufacturer.
   3. Interior Wall Joints at Masonry Walls: 6063-T5 aluminum with extruded elastomeric seal capable of accommodating multi-directional seismic movement. Watson Bowman Acme "Model WSW" or equal product of other acceptable manufacturer.
   4. Interior Wall Joints at Metal Stud Walls: Low profile expansion joint system consisting of extruded 6063-T5 aluminum rails and flexible extruded polyvinyl chloride seals, designed to accommodate new or existing construction, which incorporates a colorable elastomeric seal that demonstrates ability to remain flat during normal movement cycles. Provide a complete system. Watson Bowman Acme "Model #CWCA" or equal of other acceptable manufacturer.
   5. Concealed Carpet Floor to Floor Expansion Joint Covers: Extruded alloy 6063-T5 aluminum edge frame, clean anodized finish. Provide manufacturer's recommended expansion anchors. MM Systems "Model HSL" or equal product from other acceptable manufacturers.

END OF SECTION

DIVISION 8 – OPENINGS

08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Hollow metal door and frames.
   2. Hollow metal sidelights, windows, borrowed lights, and transom frames.
   3. Stainless steel doors and frames.

B. Referenced Standards/Minimum Criteria:
   1. Door and Hardware Preparation ANSI 115
   2. Life Safety Codes NFPA-1 (latest edition).
   3. Fire Doors and Windows NFPA-80 (latest edition)
   4. Steel Door Institute ANSI/SDI-100 (latest edition)
   5. Design Requirements: Exterior hollow metal frames shall be designed by a professional engineer registered in the State of Colorado to withstand ground wind speed in accordance with IBC. Provide reinforcing as required to meet the requirements.
   6. Materials used for stainless steel doors and frames shall be Type 304 stainless steel with #4 Satin finish in accordance with ASTM A480-19a "Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip" and A666 -15 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar".
      a. These doors and frames are typically used in swimming pool areas.
   7. Materials utilized for hollow metal doors and frames shall be cold-rolled steel conforming to ASTM A1008 / A1008M-18 "Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable". Exterior doors and frames shall receive hot-dip galvanized coating conforming to ASTM A924-19 "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process".
   8. Galvanized steel shall be treated to ensure proper paint adhesion.
   9. Supports and Anchors: Fabricated from not less than 0.0478-inch-thick steel sheet; 0.0516- inch-thick galvanized steel where used with galvanized steel frames.
   10. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153-16 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware", Class C or D as applicable.

C. Submittals Required:
   1. Product data: Include all types of doors and frames, sound ratings, hardware preparation, label compliance and finishes.
   2. Shop drawings: Include all details with reinforcement and anchorage.
   3. Colors and finishes for factory finished doors and frames.
   4. Oversized construction certification for fire door assemblies that exceed limitations of labeled assemblies, if required.

D. Restrictions/Critical Criteria:

1. Frames:

a. Fabricate metal frames for doors, transoms, sidelights, borrowed lights, and other openings, according to ANSI/SDI 100. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 0.0478-inch-thick cold-rolled steel sheet.

1) Fabricate 16 gage interior frames with mitered or coped and continuously welded corners.
2) Fabricate 14 gage exterior frames with mitered or coped corners, continuously welded corners.
3) Fabricate frames for interior openings over 48-inches wide from 14 gage, 0.0747-inch thick steel sheet.
4) Fabricate exterior frames for openings from 14 gage, 0.0747-inch-thick galvanized steel sheet.

b. Where specified, fabricate metal frames with "high frequency'' hinge reinforcements. Furnish top hinge reinforcements for doors up to 36-inches in width; furnish top, middle and bottom reinforcements for doors over 36-inches in width.

c. Door Silencers: Except on weather-stripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

d. Plaster Guards: Provide minimum 0.0179-inch thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

e. Grout: When required in masonry construction, contractor shall field apply a bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing anti-freezing agents.

2. Doors:

a. Steel Doors: Provide 1-3/4-inch-thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:

1) Interior 16 gage doors: Grade III, heavy-duty, Model 1, full flush, minimum 0.0598-inch thick cold-rolled steel sheet faces.
2) Exterior 14 gage doors: Grade III, heavy-duty, Model 1, full flush, minimum 0.06-inch thick galvanized steel sheet faces.
3) Doors shall have continuous vertical mechanical interlocking joints at lock and hinge edges with visible edge seams or with edge seam filled and ground smooth. The internal portion of the seam shall be sealed with epoxy. An intermittent fastening along the seam is not permitted.
4) Reinforcements as per ANSI A25.8.
5) Doors shall be beveled 1/8-inch in 2-inch hinge and lock edges.
6) Top and bottom steel reinforcement channels shall be 14-gage and spot welded to both panels.

7) Hinge reinforcements shall be 7 gauge for 1-3/4-inch doors. Lock reinforcements shall be 16 gage and closer reinforcements 14 gage box minimum 20-inches long. Hinge and lock reinforcements shall be projection welded to the edge of the door. Galvanized doors shall have galvanized hardware reinforcements. Adequate reinforcements shall be provided for other hardware as required. Where specified, furnish "high frequency'' hinge reinforcements.
8) Glass trim for doors with cutouts shall be 24 gage steel conforming to ASTM A 366 cold rolled steel. The trim shall be installed into the door as a four-sided welded assembly. The trim shall fit into a formed area of the door face, shall not extend beyond the door face and shall interlock into the recessed area cap of the cutout but shall not extend more than1/16" from the door face. The corners of the assembly shall be mitered, all be reinforced and welded. The trim shall be the same on both sides of the door. Exposed fasteners shall not be permitted. Label and non-label doors shall use the same trim.
9) Exterior out-swinging doors shall have tops closed to eliminate moisture penetration. Door tops shall have no holes or openings. Top caps are permitted.

3. Fabrication:
   a. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ASNI/SDI 100 requirements.
      1) Internal Construction: Follow manufacturer's standard core materials according to SDI standards:
      2) Steel stiffened Temperature rise
      3) Clearances: Not more than 1/8-inch at jambs and heads, except not more than 1/4-inch between non-fire rated pairs of doors. Not more than 3/4-inch at bottom.
         a) Fire Doors: Provide clearances according to NFPA 80.

   b. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel sheet.
   c. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and frames."
   d. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold-or hot-rolled steel sheet.
   e. Fabricate the door with steel stiffeners and deadened with fiberglass. The stiffeners shall be fabricated from 20 gauge steel located 6-inches on center and shall be welded to the inside of the face sheet 4-inches on center. The stiffeners shall be welded together at the top and bottom. The areas between the stiffeners shall be filled with fiberglass.
   f. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

g. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ASNI A115 Series specifications for door and frame preparation for hardware.
h. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
i. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
j. Glazing Stops: Minimum 0.0359-inch-thick steel or 0.040-inch-thick aluminum.
    1) Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
    2) Provide screw-applied, removable, glazing beads on inside of glass, louvers, and other panels in doors.

4. Finishes, General:
    a. Doors and frames components shall be cleaned, phosphatized and finished as standard with one coat of baked-on rust inhibiting prime paint in accordance with the ANSI A224.1 ''Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."
    b. Finished painted doors and frames shall be cleaned, phosphatized and finished with baked-on rust inhibiting paint capable of passing a 200-hour salt spray and 500-hour humidity test in accordance with ASTM test method B117 and 01735. Finished paint shall be in accordance with ANSI/SDIA250.3, "Test Procedure and Acceptance Criteria for factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames."

5. Galvanized Steel Sheet Finishes:
    a. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it.
    b. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.
    c. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with paint manufacturer's instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
        1) Color and Gloss: As selected by Architect from manufacturer's color and gloss designations.

6. Installation:
   a. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
   b. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
      1) Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
      2) In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
      3) In metal-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In steel-stud partitions, attach wall anchors to studs with screws.
      4) In in-place gypsum board partitions, install knock-down, slip-on, drywall frames.
      5) Install fire-rated frames according to NFPA 80.

   c. Door Installation: Fit hollow-meal doors accurately in frames within clearances specified in ANSI/SDI 100.
      1) Fire Rated Doors: Install with clearances specified in NFPA 80.
      2) Smoke-Control Doors: Comply with NFPA 105.

PART 2 - PRODUCTS

A. Acceptable Manufacturers – Hollow Metal Doors and Frames:
   1. Steelcraft Manufacturing Co. www.steelcraft.com.
   2. Southwestern Hollow Metal, Raton NM.
   3. Gateway Metal Products, Raton NM.
   4. Curries Manufacturing: www.curries.com.
   5. North Central Supply, Inc. www.northcentralsupply.com.
   6. CECO Door: www.cecodoor.com.
   7. Approved substitute.

08 14 16 – FLUSH WOOD DOORS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Prefinished solid core wood doors.
   2. Prefinished fire-rated wood doors.
   3. Metal glazing stops.

B. Referenced Standards/Minimum Criteria:
   1. "Architectural Woodwork Standards", latest edition, as published by the Architectural Woodwork Institute (AWI).
   2. National Fire Protection Association (NFPA) 80 and (NFPA) 252 Standard for Fire Doors.
   3. National Wood Window and Door Association (NWWDA) Industry Standards IS-1A Series.
   4. Fire-rated doors shall meet requirements of ASTM E152 and shall bear UL label or other certifying label acceptable to local building official. Metal glazing frames shall also have UL label (i.e., "B" label for 90 min. fire protection).
   5. Wood doors shall be Custom Grade per AWI "Architectural Woodwork Standards", Section 9.
   6. Installation of doors and tolerances per AWI Section 9.

C. Submittals Required:
   1. Shop drawings indicating size, hand of door, elevation of each door, extent of hardware blocking.
   2. Product data/finishing instructions for factory finished doors and available finishes.
   3. Sample corner of door with face veneer, edge and core construction of door.

D. Restrictions/Critical Criteria:
   1. Minimum door size: 36-inches wide x 7'-0" high.
   2. Provide vision panels in all doors of classrooms and offices.
   3. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4-inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01-inch in a 3-inch span, or do not comply with tolerances in referenced quality standard for the life of the installation. Doors which are replaced during the one (1) year warranty period shall be rehung and finished by the Contractor. After one (1) year warranty, replacement door shall be furnished and installed by the door manufacturer.
   4. Door veneer to be either plain sliced, premium grade AA birch or red oak. Provide running book, book matched, and hardwood edges.
   5. Solid-Core Doors:
      a. Particleboard Cores: Comply with the following requirements:
         1) Particleboard: ANSI A208.1, Grade LD-2 Type 1, Density C (28-30 pounds per cubic foot), Class 1 commercial standard 236-66.
         2) Blocking: Provide wood blocking at particleboard doors as follows:

3) 5-inch top rail locking, at doors indicated to have closers.
4) 5-inch bottom rail blocking, at doors indicated to have kick, mop or armor plates.
5) 5-inch mid-rail blocking, at doors indicated to have exit devices.
6) Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

b. Interior Veneer-Faced Doors: Comply with the following requirements:
1) Core: Particleboard core.
2) Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

c. Fire-rated Doors: Comply with the following requirements.
1) Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as required to provide fire rating indicated.
2) Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated and as follows:

Provide fire rated pairs with fire retardant stiles that are labeled and listed for kinds of applications indicated without formed steel edges and astragals.

When the above is unable to be implemented, furnish formed steel edges and astragals.

d. Positive Pressure, "S" rated fire doors requiring labeling for IBC (current edition) compliance: Provide doors that have been tested and approved for positive pressure labeling. Special sealing system, if required for "S" labeling, to be supplied by door supplier.

6. Louvers and Light Frames:
a. Wood Frames for Light Openings: As follows:
1) Wood Species: Same species as door faces.
2) Profile: Flush rectangular beads, W-6 or W-7 profiles.
3) Frames for Openings in Fire Doors: Wood frames and metal glazing clips approved for use in 20-minute fire-rated wood-core doors.

b. Wood-Veneered Beads for light Openings in Fire Doors: Manufacturer's standard wood veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.

c. Metal Frames for Light Openings: As follows:
   1) Cold rolled 20-gage steel with gray or beige primer as selected by Architect.
      a) Profile: Tapered, low profile, beveled glass stop with tight mitered corners similar to "LoPro" metal vision frame by Anemostat: www.anemostat.com, or equivalent.
      b) Fasteners: standard #8 sheet metal screws.

   2) Cold rolled 18-gage steel with gray or beige primer as selected by Architect.
      a) Profile: Tight mitered corners, 90-degree angle on glass stop for maximum visible lite area, similar to "FGS-75 Metal Vision Frame" by Anemostat: www.anemostat.com, or equivalent.
      b) Fasteners: Through bolted at top, bottom and both sides with #8-32 Phillips head, machine screw with blank head on end.

7. Fabrication:
   a. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements of NFPA 80 for fire-rated doors.
   b. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
   c. Metal Astragals: Pre-machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
   d. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
      1) Fixed Transom Panels: Fabricate fixed panels with solid lumber transom bottom rail and door top rail, both rabbeted as indicated. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

   e. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
      1) Light Openings: Trim openings with moldings of material and profile indicated.
      2) Louvers: Factory install louvers in prepared openings.

8. Shop Priming:
   a. Transparent Finish: Shop seal faces and edges of doors for transparent finish with stain, other required pretreatments, and factory finish.

9. Installation:
   a. Install wood doors to comply with manufacturer's written instructions, reference quality standard, and as indicated.
      1) Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

b. Factory Machined Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Reseal cut surfaces after fitting and machining.

c. Align doors to frame for uniform clearances as follows:
   1) Head and jambs: 1/8-inch
   2) Bottom: 3/8-inch to finished floor, 1/8-inch
   3) Meeting Stile: 1/8-inch
   4) Fire rated assemblies: per NFPA Bulletin 80
   5) Bevel non-fire-rated doors: 1/8 inch in 2 inches at lock and hinge edges
   6) Bevel fire-rated doors: 1/8-inch in 2-inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

PART 2 - PRODUCTS

A. Acceptable Door Manufacturers:
   1. Graham Wood Doors: https://architectural.masonite.com/graham-maiman/flush-wood-doors/.
   2. Masonite: www.masonite.com.
   3. Marshfield Doors: www.marshfielddoors.com.
   4. Oshkosh Architectural Door Co: www.oshkoshdoor.com.
   5. V.T. Industries, Inc. www.vtindustries.com.
   6. Approved substitute.

08 31 00 – ACCESS DOORS AND PANELS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Access doors for access to mechanical valves, plumbing chases, and electrical equipment.
   2. Floor doors.
   3. Floor doors with cover to accept carpet covering.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data including UL labeling data for rated doors.

D. Restrictions/Critical Criteria:
   1. Provide non-rated or fire-rated access doors to match fire-resistive rating of surface which access door is to be installed within, complete with key-operated cam locks.

PART 2 - PRODUCTS

A. Acceptable Manufacturers – Access Doors:
   1. Milcor: www.milcorinc.com.
   2. Karp Associates, Inc. www.karpinc.com.
   3. J.L. Industries: http://www.activarcpg.com/jl-industries
   4. Larsen's Manufacturing Co. www.larsensmfg.com.
   5. Nystrom: www.nystrom.com.
   6. Williams Brothers Corp. www.wbdoors.com.
   7. Approved substitute.

B. Acceptable Manufacturers – Floor Doors:
   1. Babcock-Davis: www.babcockdavis.com.
   2. Bilco: www.bilco.com.
   3. Nystrom: www.nystrom.com.
   4. Williams Brothers Corp. www.wbdoors.com.
   5. Approved substitute.

C. Acceptable Products - Floor Doors:
   1. Concrete Floors without Floor Finishes: Bilco Type Q-4, 3' x 3' single leaf steel (1/4-inch diamond pattern), automatic hold open arm, and steel frame or equivalent of other acceptable manufacturer.
   2. Concrete Floors with Floor Finishes: Bilco Type T-4, 3' x 3' single leaf aluminum (1/4-inch smooth aluminum plate), automatic hold open arm, molding to receive carpet or resilient flooring.

08 32 23 – SLIDING / FOLDING GLAZED DOORS AND WALLS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Factory fabricated sliding/folding glazed door/wall with frames and operating hardware.
   2. Aluminum panel frame system.

B. Referenced Standards/Minimum Criteria:
   1. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
   2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color samples for selection.

D. Restrictions/Critical Criteria:
1. Construction: Sliding doors of mid-range HC- 40 construction.
2. Support System: Floor mounted.
3. Aluminum Frames: Factory finished; manufacturer's standard corner construction; non-thermally broken.
4. Glass Stops: Same material and color as frame.
5. Aluminum Frame Finish: Anodized coating in accordance with AAMA 611.
   a. Color: Clear anodized

6. Factory assemble sliding/folding operable panel frames as single unit, including head, jambs, and bottom sections; provide concealed fasteners.
7. Sizes: Allow for tolerances of rough framed openings, clearances, and shims at perimeter of assemblies.
8. Joints and Corners: Flush, hairline and waterproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
9. Glazing: Factory installed.
10. Glazing: Single glazed, clear, fully tempered, with glass thickness 1/4-inch.
11. Door Hardware: Provide standard hardware including stainless steel track and roller, extruded aluminum pull, and keyed hook bolt lock (MS1850A-505) on exterior and thumbturn on interior. Cylinder lock by Finish Hardware supplier.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
1. "1010 Sliding Mall Front" by Kawneer Company: www.kawneer.com.
   a. Substitutions: Not permitted.

08 33 13 – COILING COUNTER DOORS

PART 1 - GENERAL

A. Summary - Section includes:
1. Non-fire-rated coiling counter doors and operating hardware.
2. Fire-rated coiling counter doors and operating hardware.
3. Electric motor operation; wiring from electric circuit disconnect to operator to control station.

B. Referenced Standards/Minimum Criteria:
1. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ITS (DIR) - Directory of Listed Products (current edition).
3. NEMA MG 1 - Motors and Generators (current edition).
4. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
5. UL (DIR) - Online Certifications Directory; current listings at www.database.ul.com.

C. Submittals Required:
1. Product data.
2. Shop drawings.

D. Restrictions/Critical Criteria:
1. Overhead rolling counter fire doors are typically used at bookkeeper or attendance office and smaller openings in rated corridor walls where the width is 4'-0" ± and the height of the opening is not more than 6'-0" ±. Manual push-up operation is not acceptable. Provide doors with a slide bolt latch on room side. The face panels shall be constructed of 22-gauge steel flat interlocking slats, factory galvanized and primed for field application of final paint. Door to close at governed speed of approximately 6- to 9-inches per second when released by fusible link or by factory supplied electro-mechanical solenoid releasing device normally de-energized and activated by 24 volt DC smoke detection system only. Door shall not close in case of power failure unless required to do so by local building official.
2. Coiling counter doors required to be fire-rated shall carry label of Underwriters Laboratories, Inc. (UL) or other acceptable independent testing laboratory indicating that product achieves fire-rating required.
3. Locate fusible links above ceiling for fire-rated doors immediately above ceiling louvers. Coordinate with fire alarm system installation.
4. Doors activated by smoke detectors and fire alarms shall be tested in the presence of the School District, Architect, and local Fire Official prior to acceptance.
5. Provide adequate size access to door/opening directly below fusible links and motors for maintenance.
6. Coiling Counter Doors, Non-Fire-Rated: Galvanized steel slat curtain.
   a. Mounting: Interior face mounted or between jambs per design.
   b. Nominal Slat Size: 1-1/4 inches wide.
   c. Slat Profile: Flat.
   d. Finish: Factory primed for field painting.
   e. Guides: Formed track; same material and finish unless otherwise indicated.
   f. Motor-operated. Manual operation not permitted.
   g. Locking Devices: Slide bolt on inside.

7. Coiling Counter Doors, Fire-Rated: Galvanized steel slat curtain.
   a. Mounting: Interior face mounted.
   b. Fire Rating: As indicated on the drawings; comply with NFPA 80.
      1) Provide product listed and labeled by ITS (DIR) or UL (DIR) as suitable for the purpose specified and indicated.

   c. Nominal Slat Size: 1-1/4 inches wide.
   d. Slat Profile: Flat.
   e. Finish: Factory primed for field painting.
   f. Guides: Formed track; same material and finish unless otherwise indicated.
   g. Coiling Door Release Mechanism: Fusible link activated with automatically governed closing speed.
   h. Motor-operated. Manual operation not permitted.
   i. Locking Devices: Slide bolt on inside.

8. Electric Operators:
   a. Mounting: Side mounted.
   b. Motor Enclosure: NEMA MG 1.
   c. Motor Rating: As recommended by manufacturer; continuous duty.
   d. Motor Voltage: 24 volt, single phase, 60 Hz.
   e. Opening Speed: 6 inches per second.
   f. Manual override in case of power failure.

9. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each operator.
   a. Key switch operated
   b. 24 volt circuit.
   c. Surface mounted.
   d. Locate on wall adjacent to opening inside of room.

10. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Coiling Counter Doors: "DuraShutter – Standard" by Raynor: www.raynor.com, or comparable product by one of the following:
      a. The Cookson Company: www.cooksondoor.com.
      b. Cornell Iron Works, Inc. www.cornelliron.com.
      c. Approved substitute.

   2. Coiling Counter Fire Doors: "FireCurtain" by Raynor: www.raynor.com, or comparable product by one of the following:
      a. The Cookson Company: www.cooksondoor.com.
      b. Cornell Iron Works, Inc. www.cornelliron.com.
      c. Approved substitute.

08 33 23 – OVERHEAD COILING DOORS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Fire-rated and non-fire-rated service doors.
   2. Insulated service doors.

B. Referenced Standards/Minimum Criteria:
   1. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
   2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Finish samples for verification.

D. Restrictions/Critical Criteria:
   1. Insulated overhead rolling service doors are typically used on the field building of a middle school or high school. The doors shall be motor operated with manual chain back-up, and lockable by means of padlock provided by the Owner. The face panels are interlocking 24 gauge steel flat front slat and back with foamed-in-place polyurethane insulation and are factory galvanized and primed for field application of final paint or factory finish.
   2. Structural Performance, Exterior Doors: Capable of withstanding the wind loads as indicated on Drawings.
      a. Testing: According to ASTM E 330/E 330M.
      b. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
      c. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
   3. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
      a. Component Importance Factor: 1.5.
   4. Operation Cycles: Door components and operators capable of operating for not less than 20,000, and not less than 10 cycles per day.

5. Insulated Door Assembly:
   a. Insulated Service Door: Heavy duty overhead coiling door, formed with curtain of interlocking metal slats.
   b. Air Infiltration: Provide manufacturer's standard air infiltration package, including guide cover and cap, dual brush guide seal, lintel seal, and bottom astragal.
   c. Curtain R-Value: not less than 6.0 deg F x h x sq. ft./Btu.
   d. Door Curtain Material: Galvanized steel.
   e. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
      1) Vision Panels: Glazed openings approximately 1-inch by 10-inches.
      2) Insulated-Slat Interior Facing: Metal, matching exterior face.
      3) Gasket Seal. Manufacturer's standard continuous gaskets between slats.

   f. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

6. Door Curtain Materials and Construction:
   a. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
      1) Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
      2) Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet; set in glazing channel secured to curtain slats.
      3) Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
      4) Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

   b. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats. Provide removable stops on guides to prevent overtravel of curtain.
   c. Door Curtain Finish: Baked-Enamel or Powder-Coated Finish: Color selected by Architect from manufacturer's full range of not less than 200 colors.

7. Hoods: Manufacturer's standard.
8. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
   a. Lock Cylinders: As specified in Division 08 Section "Door Hardware".
   b. Keys: Two for each cylinder.

9. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

10. Electric Door Operators:
    a. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
        1) Comply with NFPA 70.
        2) Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

    b. Motors: Reversible-type motor for motor exposure indicated for each door assembly.
    c. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
    d. Control Station: Three-button control station in fixed location with momentary-contact pushbutton controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
        1) Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general purpose NEMA ICS 6, Type 1 enclosure.

11. Curtain Accessories:
    a. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
    b. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
    c. Push/Pull Handles: Equip emergency-operated door with lifting handles on each side of door, finished to match door.
    d. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:
        1) Building fire-detection, smoke-detection, and -alarm systems.

12. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 30 lbf.
13. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

14. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
15. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.
16. Electric Door Operator:
    a. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
    b. Motor Exposure: Interior.
    c. Obstruction-Detection Device: Automatic manufacturer's standard sensor edge on bottom bar.
        1) Sensor Edge Bulb Color: Black.

    d. Control Station(s): Interior mounted.
    e. Other Equipment: Audible and visual signals.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
    1. "Stormtite Model 625" by Overhead Door Corp. www.overheaddoor.com, or comparable product by one of the following:
        a. Clopay Building Products: www.clopaydoor.com.
        b. Cornell Iron Works, Inc. www.cornelliron.com.
        c. Approved substitute.

08 33 26 – OVERHEAD COILING GRILLES

PART 1 - GENERAL

A. Summary - Section includes:
    1. Overhead coiling metal grilles and operating hardware, manual and electric operation.

B. Referenced Standards/Minimum Criteria:
    1. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
    2. ITS (DIR) - Directory of Listed Products (current edition).
    3. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
    4. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata.
    5. NEMA MG 1 - Motors and Generators (current edition).
    6. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
    7. UL (DIR) - Online Certifications Directory; current listings at www.database.ul.com.

C. Submittals Required:
    1. Product data.
    2. Shop drawings.

D. Restrictions/Critical Criteria:

1. The overhead coiling grilles are typically used to close off any area of the building where the size of the grille is approximately 8'-0" wide x 8'-0" high. The operation is manual push-up/pull down (provide pull down pole). Rolling grille is constructed of mill finished aluminum horizontal rods and vertical chain curtain with extruded aluminum tubular bottom bar. Finish to be anodized aluminum.
2. Grille and Components:
   a. Grille: Aluminum; horizontal bar curtain, coiling on overhead counterbalanced shaft.
      1) Finish: Anodized, clear color.
      2) Electric operation.
      3) Mounting: Surface mounted.

   b. Curtain: Round horizontal bars connected with vertical links.
      1) Horizontal bars: 5/-inch diameter.
      2) Bar spacing: 1-1/2-inch on center.
      3) Tube spacers: 1/2-inch diameter.
      4) Spacer spacing: 3-1/4-inches on center.
      5) Link spacing: 6-inches on center.
      6) Bar Ends: Provide with nylon runners for quiet operation.
      7) Bottom Bar: Back-to-back angles with tubular resilient cushion.

   c. Guides: Extruded aluminum angles, of profile to retain grille in place with snap-on trim, mounting brackets of same metal.
   d. Hood Enclosure: Sheet metal; completely covering operating mechanisms; internally reinforced to maintain rigidity and shape.
      1) Material: Same metal as grille.
      2) Finish: Anodized, color as selected.

   e. Lock Hardware:
      1) Latchset Lock Cylinders: Standard mortise cylinder master keyed to building.
      2) For motor operated units, additional lock or latching mechanisms are not required.
      3) Latch Handle: Manufacturer's standard.
      4) Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.

   f. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.
   g. Provide pull down poles.

3. Electric Motor Operation:
   a. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
      1) Provide interlock switches on motor operated units.

b. Electric Operators:
   1) Mounting: Side mounted.
   2) Motor Enclosure:
      a) Motor Rating: 1/3 hp (250 W); continuous duty.
      b) Motor Voltage: 230 volt, single phase, 60 Hz.
      c) Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
   3) Controller Enclosure: NEMA 250 Type 1.
   4) Opening Speed: 12 inches per second (300 mm/s).
   5) Brake: Adjustable friction clutch type, activated by motor controller.
   6) Manual override in case of power failure.

4. Control Station: Standard three button (OPEN-STOP-CLOSE) constant pressure control for each operator.
   a. Key switch operated
   b. 24 volt circuit.
   c. Recessed.
   d. Locate on wall adjacent to opening inside of room.

5. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Overhead Coiling Grilles: "DuraGrille" by Raynor: www.raynor.com, or comparable product by one of the following:
      a. The Cookson Company: www.cooksondoor.com.
      b. Cornell Iron Works, Inc. www.cornelliron.com.
      c. Approved substitute.

08 36 13 – SECTIONAL DOORS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Overhead sectional doors, electrically operated.
   2. Operating hardware and supports.
   3. Electrical controls.

B. Referenced Standards/Minimum Criteria:
   1. ASTM E330/E330M – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

2. DASMA 102 – American National Standard Specifications for Sectional Overhead Type Doors.
3. NEMA MG 1 – Motors and Generators; 2014.
4. NFPA 70 – National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction; including all applicable amendments and supplements.

C. Submittals Required:
1. Product data.
2. Shop drawings.

D. Restrictions/Critical Criteria:
1. Steel Door Components:
a. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
1) Performance: Withstand positive and negative wind loads as calculated in accordance with applicable code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using prescribed duration of maximum load.
2) Thermal Values: R-value of 16.22; U-value of 0.0616.
3) Air Infiltration: 0.07 cfm at 15 mph.
4) Sound transmission class 20 when tested in accordance with ASTM E 413.
5) Outdoor-indoor transmission class 20 when tested in accordance with ASTM E 1332.
6) Door Nominal Thickness: 2 inches thick.
7) Exterior Finish: Hot dipped galvanized for field finishing.
8) Interior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
9) Ends: 16-gauge hot-dipped galvanized steel, full height with end caps.
10) Operation: Electric.
a) Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3-foot nor more than 1 foot per second.
b) Entrapment Protection: Required for momentary contact, includes radio control operation.
c) Photoelectric sensors monitored to meet UL 325/2010.

11) Operator Controls:
a) Flush mounted control station with open, close and stop buttons.
b) Locate inside crawlspace adjacent to opening.

12) Hardware: Provide interior slide locks with exterior keyed access

b. Door Panels: Steel construction; outer steel sheet of 20 gage, 0.0359 inch minimum thickness, flush profile; inner steel sheet of 20 gage, 0.0359 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

c. Doors to have 2-inch normal head room track, angle-mounted to structure above, with electric operator.
d. Provide 2 slide locks. Padlocks provided by Owner.

2. Aluminum Door Components:
   a. Aluminum Doors: Stile and rail aluminum with glazed panels; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
      1) Door Nominal Thickness: 2-inches.
      2) Finish: Factory anodized; clear anodized.
      3) Glazed Lights: Full panel width, one row; set in place with resilient glazing channel.
      4) Operation: Electric.
         a) Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3-foot nor more than 1 foot per second.
         b) Jack Shaft Type - Standard Duty - 1/2 HP

      5) Entrapment Protection: Required for momentary contact, includes radio control operation.
      6) Photoelectric sensors monitored to meet UL 325/2010.
      7) Operator Controls: Locate inside of room.
         a) Key operated control stations with open, close, and stop buttons.

   b. Window Frame: To match door panels, finish to match.
   c. Glazing: Fully tempered glass; single pane; clear; 1/4-inch thick.
   d. Hardware: Provide interior slide locks and galvanized hanger angles and tracks
   e. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
      1) Size: 2-inch.
      2) Type: Standard lift.

   f. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
   g. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
   h. Weatherstripping (Exterior Door applications):
      1) Flexible bulb-type strip at bottom section.
      2) Flexible Jamb seals.
      3) Flexible Header seal.

   i. Panel Joint Weatherstripping: Neoprene foam seal, one-piece full length.
   j. Lock: Keyed lock with interlock switch for automatic operator.

3. Electrical Operation:
   a. Electrical Characteristics: 1/2 hp (375 W); manually operable in case of power failure, transit speed of 12 inches per second.
   b. Motor: NEMA MG 1, Type 1.
   c. Disconnect Switch: Factory mount disconnect switch in control panel.
   d. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.
   e. Safety Edge: At bottom of door panel, full width; electro-mechanical sensitized type, wired to reverse door upon striking object; hollow neoprene covered to provide weatherstrip seal.
   f. Control Station: Standard three button (Open-Close-Stop) momentary type control for each electric operator.
      1) 24-volt circuit.
      2) Surface mounted.
      3) Locate at inside door jamb.

   g. Hand-Held Transmitter: Digital control, resettable.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Steel Doors:
      a. "SteelForm S20" by Raynor: www.raynor.com, or comparable product by one of the following:.
         1) Clopay Building Products: www.clopaydoor.com.
         2) The Cookson Company: www.cooksondoor.com.
         3) Approved substitute.

   2. Aluminum Doors:
      a. "AlumaView AV200" by Raynor: www.raynor.com, or comparable product by one of the following:
         1) Clopay Building Products: www.clopaydoor.com.
         2) The Cookson Company: www.cooksondoor.com.
         3) Approved substitute.

08 41 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

and

08 44 13 – GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Aluminum storefront window units/accessories, including aluminum fixed windows.
   2. Glazed aluminum curtain walls.

B. Referenced Standards/Minimum Criteria:
   1. Windows and component structural tests shall conform to the "Voluntary Guide Specification for Aluminum Architectural Windows" as published by AAMA for air infiltration, water infiltration, structural performance, thermal movements and thermal performance.
   2. Design per wind loading requirements of IBC.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Samples of aluminum finish and storefront cross section.
   4. Test Reports.
   5. Design Engineering Calculations: Submit structural calculations prepared by registered engineer in the State of Colorado for review purposes. Calculations shall indicate adequacy of curtain wall system to meet the wind loading and structural load requirements of the IBC. Design engineer shall size and locate any internal steel reinforcing required within framing members to meet system design criteria.

D. Restrictions/Critical Criteria:
   1. Provide framing members and components with joints neatly made, free of burrs, and tight fitting to provide hairline joints with ends coped, mitered, milled or machined as appropriate. Members shall be securely fastened or joined to develop full structural value of framing system and to provide permanent watertight joints.
   2. Drainage System: Provide weep holes and drainage slots within glazing pockets to drain any condensation or accumulating water within the system to exterior.
   3. Reinforcements: Reinforce framing members as necessary to meet structural performance for loading criteria.
   4. Aluminum Window Sills and Trim: Extruded aluminum having same finish and thickness of frames.
   5. Finish: Color anodized finish of exposed areas of aluminum members and components in accordance with AAMA Voluntary Guide Specifications AA-M12C22A42/44.
   6. Comply with manufacturer's instructions for installation of components to achieve weathertight installation.

7. Apply coat of bituminous paint or zinc chromate on concealed aluminum surfaces in contact with cementitious or dissimilar materials.
8. Uses of sealant materials, both at the factory and at the project site shall be in strict accordance with ASTM Specifications for such materials. Contractor shall ensure that joints, gaps, buttered surfaces, and other surfaces are made weathertight.
9. On site tests shall be conducted for both air and water infiltration with the wall manufacturer's representative present. Architect will select unit(s) to be tested. Testing shall be conducted by qualified testing personnel selected by the Architect and window manufacturer (if required).
    a. Air infiltration tests on wall units and insert windows shall be in accordance with ASTM E783.
    b. Water infiltration tests shall be in accordance with AAMA 501.3: No uncontrolled water to appear on interior surface.

10. Manufacturer shall provide a ten (10) year warranty on materials and workmanship.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
    1. Kawneer Company, Inc. www.kawneer.com.
    2. Vistawall (Oldcastle Building Envelope): www.obe.com.
    3. Tubelite, Inc. www.tubeliteinc.com.
    4. Approved substitute.

B. Acceptable Aluminum Curtain Wall Framing System: Kawneer "1600 Wall System" or equal system of other approved manufacturer. Outside glazed extruded 6063-T5 aluminum framing system. Framing members shall be 2-1/2-inch x depth required for wind loading.

C. Acceptable Manufacturer and Type for Storefront and Fixed Windows: Kawneer "451T Storefront Framing System" or equal of other acceptable manufacturer. Extruded aluminum shall be 6063-T5 alloy and temper. Frames shall have integral structural thermal barrier. Mechanically fasten for flush, tight, and weatherproof joints. Frame dimensions shall be minimum 2- x 4-1/2-inches nominal.

08 45 00 – TRANSLUCENT WALL AND ROOF ASSEMBLIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Translucent insulated skylight system, including all related trim, sills, closures, and flashings.

B. Referenced Standards/Minimum Criteria:
   1. Structural design shall be in compliance with the provisions of Chapter 16 of the 2015 International Building Code (IBC). Design, engineer, fabricate, and install System to withstand the applicable loads and load combinations described therein.
   2. Design wind load shall be based on a 3-second gust wind velocity (V_{ULT}) of 120 mph, Exposure C, or per site conditions.
   3. Exterior face sheet of panels shall withstand a 60 foot pound impact.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Samples.
   4. Certifications.

D. Restrictions/Critical Criteria:
   1. Framing System:
      a. Standard Thermal Break Framing System with panel joint connectors, battens, and perimeter frame. Furnish all required and detailed sections.
      b. Extruded 6063-T6 and 6063-T5 aluminum screw "clamp-tite" closure system.
      c. Exposed Aluminum: Class I clear anodized finish conforming to AAM12C22A41.
      d. Architectural corrosion resistant finish which meets the performance requirements of AAMA 2604, color to be selected from manufacturer's standard colors.

   2. Panels: Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken (aluminum) I-beams.
      a. 2-3/4-inch thick factory prefabricated sandwich panels.
      b. Exterior face sheet shall be 0.070-inch thick "crystal" with interior face sheet of 0.045-inch thick "crystal".
      c. Panels shall have "U" Factor of 0.23, light transmission of 30%, and solar heat gain coefficient of 0.33.
      d. Pattern shall be standard "Shoji" with 12- x 24-inch grids.

   3. Sealing Tape: Manufacturer's standard pre-applied to closure system at the factory under controlled conditions.
   4. Accessories: Furnish all hardware, anchors, and related items necessary for complete and weathertight installation.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Skylight Types:
      a. Kalwall "Supported Ridge" Translucent Skylight by Kalwall Corporation: www.kalwall.com.
      b. Kalwall "Self-Supported Ridge" Translucent Skylight by Kalwall Corporation: www.kalwall.com.

   2. Other Manufacturers:
      a. Skywall Translucent Systems: www.vistawall.com.
      b. Major Industries: www.majorskylights.com.
      c. Approved substitute.

08 51 00 – ALUMINUM WINDOWS (Factory Assembled)

PART 1 - GENERAL

A. Summary - Section includes:
   1. Fixed aluminum windows.
   2. Operable aluminum windows.

B. Referenced Standards/Minimum Criteria:
   1. National Fenestration Rating Council NFRC).
   2. American National Standards Institute/American Architectural Manufacturers Association (ANSI/AAMA) Aluminum Prime Window Voluntary Specification.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Test reports for air infiltration, water resistance, wind loading, and thermal performance.

D. Restrictions/Critical Criteria:
   1. Window manufacturer to provide minimum five (5) year warrantee covering defects in materials and workmanship.
   2. Window to be ANSI/AAMA rating or better (minimum wall thickness 0.062-inch) with thermal break design, internal to exterior drainage, weather stripping per AAMA 701.2, and extruded aluminum sills and trim, no break metal allowed.
   3. Apply coat of bituminous or zinc chromate paint on aluminum surfaces in contact with cementitious or dissimilar materials.
   4. Windows to have cam handle locks and 4-bar hinges with 15-degree limit stops.
   5. The color of the anodized frames shall be approved by the School District.
   6. Confirm with Owner if glass is to be provided by window manufacturer or glazing contractor.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products
   1. Awning or fixed window with no screens "Series 8225TL Thermal Windows" by Kawneer: www.kawneer.com, or comparable products by one of the following:
      a. Win-Vent: www.winventwindows.com.
      b. Winco Windows: www.wincowindow.com.
      c. Manko: www.mankowindows.com.
      d. Approved substitute

08 63 00 – METAL FRAMED SKYLIGHTS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Metal framed skylights.
   2. Glazing and accessories.

B. Referenced Standards/Minimum Criteria:
   1. Engineered by manufacturer to prevent wind blow-off and live/dead loads per IBC with minimum air filtration per ASTM E283 and no uncontrolled water leakage per ASTM E331 testing.
   2. Manufacturer and installer shall warrant that the framing system and completed installation shall be free of defects in workmanship and materials and system shall remain watertight for a period of five (5) years from date of substantial completion.
   3. Insulated glazing units shall be warranted by manufacturer for a period of five (5) years from date of manufacture against seal failure.
   4. Glazing gaskets shall be flexible EPDM extrusions conforming to ASTM C864 or ASTM C509 at entire perimeter of glazing materials. At no place shall direct contact exist between glazing and metal.

C. Submittals Required:
   1. Product Data.
   2. Shop drawings.
   3. Structural calculations per AAMA Structural Design Guidelines for Aluminum Framed Skylights by engineer licensed in the State of Colorado.
   4. Color Options.
   5. Sample of warranty.

D. Restrictions/Critical Criteria:
   1. Water test skylights upon completion. Thoroughly wet the entire skylight area in accordance with referenced test and check for uncontrolled water leakage.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Vistawall (Oldcastle Building Envelope): www.obe.com, "HP-1175 Sloped Glazing" with integral condensation gutters and 1-inch double sealed insulating glass with tempered outside glass and laminated glass inside face. Finish of aluminum as approved by the School District.
   2. Dalyte (AIA Industries): www.dalyte.com.
   3. Skyline Skylights: www.skylites.com.
   4. Kawneer: www.kawneer.com.

08 64 00 – PLASTIC SKYLIGHTS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Double-dome plastic skylights.

B. Referenced Standards/Minimum Criteria:
   1. Skylights shall be engineered by the manufacturer to prevent wind blow off and to provide a minimum carrying capacity of 40 lb. live load per square foot of skylight.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Glazing shall be one piece continuous cast acrylic resin plastic, with tinted outside dome and clear inside dome. Mounted on thermal barrier extruded aluminum frame with integral condensate gutter.
   2. Water test skylights upon completion. Conduct test using a hose without nozzle and thoroughly wet the entire skylight area.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Plasteco: www.plasteco.com.
   2. Dalyte (AIA Industries): www.dalyte.com.
   3. Skyline Skylights: www.skylites.com.
   4. Solatube: www.solatube.com.
   5. Velux: www.veluxusa.com.
   6. Approved substitute.

08 70 10 – DOOR HARDWARE

PART 1 - GENERAL

A. Summary - Section includes:
   1. Finish hardware.
   2. Cylinders for overhead, coiling, and sliding doors and key switches for ADA actuators and mag holder furnished under this section but not installed.

B. Referenced Standards/Minimum Criteria:
   1. Builders Hardware Manufacturers Association (BHMA).
   2. American National Standards Association (ANSI).
   3. ANSI A117.1 - Specifications for making buildings and facilities usable by physically handicapped people.
   4. ADA - Americans with Disabilities Act.
   5. DHI - Door and Hardware Institute.
   6. NFPA- National Fire Protection Association.
      a. NFPA 80 - Fire Doors and Windows.
      b. NFPA 101 - Life Safety Code.
      c. NFPA 105- Smoke and Draft Control Door Assemblies.
      d. NFPA 252 - Fire Tests of Door Assemblies.
   7. UL- Underwriters Laboratories:
      a. UL10C - Fire Tests of Door Assemblies (Positive Pressure).
      b. UL 305 - Panic Hardware.
   8. WHI - Warnock Hersey Incorporated.
   9. SDI - Steel Door Institute.
   10. WDMA Industry Standard I.S. 1-A-97 (Window & Door Manufacturers Association).
   11. AWI Quality Standards, current edition.
   12. ANSI A115. W Series, Wood Door Hardware Standards. (American National Standard Institute).
   13. NAAMM - National Association of Architectural Metal Manufacturers.

C. Submittals Required:
   1. Product data / Shop drawings:
      a. Type, style, function, size, quantity and finish of hardware items. Use BHMA Finish codes per ANSI A156.18.
      b. Name, part number and manufacturer of each item.
      c. Fastenings and other pertinent information
      d. Location of hardware set coordinated with floor plans and door schedule
      e. Explanation of abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for hardware.
      g. Door and frame sizes, materials and maximum degrees of swing.
      h. List of manufacturers used and their nearest representative with address and phone numbers.

i. Catalog cuts.
j. Manufacturer's technical data and installation instructions for electronic hardware.
k. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, wiring/riser diagrams, manufacturers' installation, adjustment and maintenance information, and hardware consultant's final inspection report.

2. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware. Present special tools and maintenance instructions to Owner at time of testing and demonstration interval.
3. Operating and maintenance manuals at closeout.
   a. Bound in 3-ring, three (3) inch black binders, indexed by the following:
      1) Project Record Documents and Shop Drawings (hard copy) with one electronic data file, Microsoft Word, CD or 3.5" disc. Format to Owner's operating systems.
      2) Manufacturer listing with name, address and phone number and catalog cut sheets of each item supplied.
      3) Installation instructions, maintenance manuals including operating and maintenance
      4) instructions.
      5) Parts listing with IR sources and IR Distribution Purchasing and Service Program participants.
      6) Warranties.

   b. Submit directly to, return receipt requested:

      Cherry Creek School District No. 5 Facilities Management
      9301 East Union Ave.
      Greenwood Village, Colorado 80111
      Attention: Steve Skene

4. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
5. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
6. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable time during the course of the Work, for consultation. The supplier shall be an approved factory direct supplier and maintain the following hardware and is currently stocking replacement parts.

7. Shop Drawings: Details of electrified door hardware, indicating the following.
   a. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
   b. Wiring Diagrams: power, signal, and control wiring. Including the following:
      1) System schematic.
      2) Point-to-point wiring diagram.
      3) Riser diagram.
      4) Elevation of each door.

   c. Operating Narrative: Describe the operation of doors controlled by electrified door hardware.
      1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter, authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

   d. Scheduling Responsibility: Preparation of door hardware and keying schedules.
   e. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
   f. Electrified Door Hardware Consultant Qualifications: A qualified Architectural Hardware Consultant who is experiences in providing consulting services for electrified door hardware installations.
   g. Wiring and Riser Diagrams: Supplier shall furnish, electrical wiring and riser diagrams for low voltage security hardware equipment specified in this Section. Provide elevation drawings indicating door numbers, associated electronic security equipment such as power supplies and interconnections between door system components, control wiring for electric locks, indicator signal lights and sounding devices which are contained in the approved hardware Submittals. Elevations shall indicate standard electrical enclosures detailing the manufacturer's space and attaching requirements.

D. Restrictions/Critical Criteria:
   1. Scheduled Hardware
      a. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in Article 3.05. Products are identified by using hardware designation numbers of the following:
         1) Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified for each hardware type, the equivalent product of one of the other manufacturers that complies with requirements.

2. Materials and Fabrication
   a. Manufacturer's Name Plate: Do not use products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
      1) Manufacturer's name will not be permitted on cylinders or keys.

   b. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
   c. Fasteners: Provide hardware manufactured to conform to published templates generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
   d. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
   e. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru bolt or use sex screw fasteners.
   f. Fire-Rated Openings: In compliance with NFPA 80. Hardware UL10C (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, plus resilient and required intumescent seals. Furnish openings complete.
   g. Where exit devices are required on fire rated doors, (with supplementary marking on door label indicating "Fire Door to be Equipped with "Fire Exit Hardware"), provide label on exit device indicating "Fire Exit Hardware".

3. Hinges and Spring Hinges:
   a. Hinges shall be 3-knuckle, concealed, Nylatron self-lubricating, vertical and lateral thrust bearings and shall be certified to exceed two million, five hundred thousand (2,500,000) full load-operating cycles by a recognized independent testing laboratory. Templates: Except for hinges to be installed entirely (both leaves) into wood doors and frames provide only template produced units.
   b. Screws: Provide Phillips flat-head screws complying with the following requirements:
      1) For metal doors and frames install machine screws into drilled and tapped holes.
      2) For wood doors and frames install wood screws.

3) For fire-rated wood doors install #12 x 1-1/4-inch, threaded-to-the-head steel wood screws.
4) Finish screw heads to match surface of hinges or pivots.

c. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
1) Out-Swing Doors with Locks: Non-removable pins (NRP).
2) Interior Doors: Non-rising pins.
3) Tips: Flat button and matching plug, finished to match leaves.
4) Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90 inches or less in height and one additional hinge for each 30-inches of additional height. Unless otherwise specified, hinge size for doors through 3'-0" shall be 4-1/2-inches x 4-1/2-inches.
5) Hinges for doors over 3'-0" wide shall be four ball bearing, heavy weight, 0.190-inch, 5-inches x 4-1/2 inches.
6) Option: Doors over 3'-0" wide shall receive four (4) heavy weight, 0.190-inch, 4-1/2 inches x 4-1/2 inches.
7) Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 inches or less in height with same rule for additional hinges.

4. Maintenance:
a. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware. Present special tools and maintenance instructions to Owner at time of testing and demonstration interval.

5. General Warranty: Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
a. Hardware Manufacturers Warranty: All hardware shall be free of defects and imperfections in manufacture and finish. Hardware shall be guaranteed by the manufacturer to perform all the various functions required for, twenty-four, (24) months from date of Substantial Completion.
b. Provide the following special warranties for the following items:
1) Everest/Primus keys: Life of Building.
2) Locksets, cylinders and latchsets: 7 years.
3) Door Closers: 10 years.
4) Exit devices: 3 years.
5) Automatic Operators: 2 years.

6. Keying Systems:
   a. Meet with Architect and Owner to finalize keying requirements and obtain keying instructions in writing. Integrate locks and cylinders with Owner's existing Everest D patent protected keying system with specifically assigned milled side bar. Cylinders must allow for applications of multiplex keying capabilities and multiple keyways. Key bittings shall be registered by the lock manufacturer. Keying services shall be performed by Owner's authorized keying services, where permanent records are maintained. Owner shall provide key bittings.
   b. Furnish cylinders with temporary interchangeable core construction keying system during construction period. Temporary cores and keys remain property of hardware supplier.
      1) Furnish permanent cores zero (0) bitted, Everest/Primus D245 keyway. Deliver permanent cores direct to Owner for keying.
      2) Furnish temporary construction cylinders at exterior doors. Medeco cylinders shall be sub-assembled for Owner assembly and keying. Permanent Medeco cylinders shall be installed by General Contractor after substantial completion.
      3) Owner's authorized keying service shall remove temporary construction cores and install permanent keyed cores into locksets and cylinders. Return temporary construction cores to hardware supplier.

   c. Keys and Key Blanks: Furnish of nickel silver to maintain security and safety of keying system and accuracy in keys and long cylinder wear.
      1) Key blanks shall be available only from factory-direct sources, not available from after market key blank manufacturers.
      2) All keys shall be embossed "Do Not Duplicate." Keys and cylinders shall be stamped with the applicable key mark for identification. Stamp all keys in sequence. Visual stamped key control on keys, indelible marking on cylinder bodies.
      3) Architect and Owner shall approve stampings and markings prior to ordering of locksets and cylinders, furnish Owner's written approval of the system.

   d. Do not package permanent keys with locks. Package key separately from locksets and cores. Deliver all keys, key blanks and other security keys direct to Owner from lock manufacturer by secure courier, return receipt requested.
   e. Failure to properly comply with these requirements may be cause to require replacement of all or any part of the keying system, cores, cylinders and keys involved as deemed necessary at no additional cost to the Owner.
   f. Key Quantity: Furnish keys in the following quantities (verify quantities for size of job with school district):
      1) 25 each - Temporary construction keys to General Contractor
      2) 6 each - Temporary construction control keys to Owner
      3) 10 each - Permanent Core Control keys to Owner
      4) 3 each - Change keys per cylinder to Owner
      5) 10 each - Emergency keys per cylinder to Owner
      6) 500 each - Key blanks, each type used, to Owner
      7) 1 each - Lock service kit to Owner

7. Locksets and Latchsets:
   a. An approved (BHMA) Builder's Hardware Manufacturers Association testing laboratory shall certify locksets to exceed three million (3,000,000) full load operating cycles.
   b. Locksets and latchsets shall be non-handed, heavy-duty cylindrical type, with 2-3/4-inch backset or greater, as specified, with 1/2-inch throw latchbolt. Manufacturer lock chassis from cold rolled steel, with locking spindles of deep drawn cold rolled steel. Spindles to resist deforming under sever torque.
   c. Lever trim shall be designed to increase resistance against vandalism and forced entry by over torquing of lock chassis. Disablement of secured levers shall not permit latchbolt retraction from secure side while allowing emergency egress.
   d. Furnish units with concealed through-bolts and threaded chassis hubs to prevent lever torque from rotating lock chassis and maintain correct alignment. Equip units with cast auxiliary spring cages with studs to prevent rotation attached directly to the lock chassis to assist in support of levers. Spring cage units shall contain coil compression springs to maintain life safety and provide extended service.
   e. Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
   f. Interface Owner's existing keying system with specified locksets. Furnish complete and fully operational locksets and cylinders.

8. Exit Devices and Mullions:
   a. Provide exit devices of single manufacturer with specified functions, which can accept exterior and interior cylinders of specified cylinders. Exit devices shall be certified to exceed three million, 3,000,000, full load-operating cycles by a recognized independent testing laboratory.
   b. Provide exit devices with specified functions, which can accept specified cylinders. Exit devices shall have ribbed interior body to discourage vandalism and graffiti. Releasable with 15 lb. maximum pressure under 250-lb. load to the door. Where specified furnish special cylinder (SD) dogging to replace standard hex key dogging.
   c. Equip devices with dead locking latchbolts. Furnish through bolted fasteners for all devices. Where required, provide projecting glass bead stop kits to provide clearance when used with projecting glass stops. Furnish glass bead stop kits at locations using both exit devices and electric strikes.
   d. Lever handle trim shall have a mechanism to disengage lever from operating should excessive force be applied, and allow lever to be re-set to its operating position. Lever design to match lock manufacturer's lever design. Provide keyed security removable mullions, which will accept security cylinders of specified cylinder manufacturer, to allow removal by use of the cylinder. Mullions to be furnished with a self-locking mechanism for re-installation without the use of the cylinder. Equip each mullion with mullion stabilizers to maintain integrity between door and mullion to prevent vandalism.
   e. Electrically actuated devices shall retract latchbolts instantly without delay for momentary unlocking or for extended periods of time. Solenoids shall be continuous duty, 24 volt, direct current, and 16.0-amp inrush. Devices shall be UL approved for Class II circuit applications.

9. Closers:
   a. Closers shall be certified to exceed ten million (10,000,000) full load-operating cycles by a recognized independent testing laboratory.
   b. Where manual closers are indicated for doors required to be accessible to the physically challenged, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing. Except as specifically indicated, comply with manufacturer's recommendations for size of door control units, depending upon size of door, exposure to weather, and anticipated frequency of use.
   c. Closers shall be cast iron construction with forged lever arms, independent adjusting valves for closing, latching and back check. Hydraulic regulation controlled by tamper-proof, non critical screw valves. All closer adjustments shall be shielded by metal cover plate after installation.
   d. Furnish extra duty arms, EDA, to protect against excessive force. Provide special templated arms to allow clearance and applications of overhead stops and holders. Closers installed on exterior doors and interior doors in high traffic areas, shall be equipped with advanced variable backcheck, AVB, function.
   e. Provide combination door closer and electromagnetic holder designed to hold door in open position. Under normal usage and to release and automatically close door under fire conditions. Incorporate an integral electromagnetic holder mechanism designed for use with UL listed fire detectors, provided with normally closed switching contacts. Provide integral smoke detector device in combination door closers and holders complying with UL 228.
   f. Install closers to allow maximum degree of opening, position back check to activate well in advance of the stop position to cushion the opening swing and prevent door and frame damage. Unless specified, install closers with through bolt mounting method on metal and wood doors.
      1) Template and install door closers for maximum degree of door swing.

   g. Operating Voltages: Coordinate operating power requirements with Fire/Life Safety control systems.

10. Pneumatic-Hydraulic Power Door Operators:
   a. Closer body shall be certified to exceed ten million (10,000,000) full load-operating cycles by a recognized independent testing laboratory. Shall conform to ANSI A156.19; ADA law, section 4.13.12; ANSI A117.1.
   b. System shall be a pneumatically and electrically powered, surface; door mounted overhead operator to provide easy access for physically handicapped persons. Opening force and time to close standards shall be in compliance with ADA requirements. Full closing force shall be provided when power cycle ends.
   c. Power door operator system shall include features and functions as follows:
      1) Cylinder operated key switch to enable/disable power to actuators.
      2) Provisions for separate conduits to carry high and low voltage wiring in compliance with applicable National Electrical Code requirements.

3) Provide building emergency electrical operating power to control box. Operator shall be designed to prevent damage to mechanism if system is actuated while door is latched or if door is forced closed during opening cycle.
4) Provisions in control box or module shall provide control (inputs and outputs) for electric strike delay, auxiliary contacts, sequential operation, fire alarm systems, actuators, swing side sensors, and stop side sensors. Coordinate installation of control box and hardwired actuators with Electrical Contractor.
5) Door operator (closer) shall be fabricated using high strength cast iron cylinder and one piece forged steel piston with forged steel main arm. Units shall be sealed and filled with all-weather fluid. Furnish fully concealed tamper proof, pneumatic power transfers, LCN 460. Units shall provide continuous protection for the enclosed pneumatic tube, when doors are in the open position.

d. Furnish and provide complete system with components necessary for proper installation, including door closer (operator), actuators at each side of door, connectors, wiring, compressors, tubing and other components as needed.
e. Actuators shall be as indicated on drawings. Provide two actuators per opening one on each side of door for access from either direction.
f. Activation and safety devices: Wall push-plate switch: Manufacturer's standard semi-flush, wall mounted, door control switch; consisting of round or square, flat push plate; of material indicated; and actuator mounted in recessed junction box. Provide engraved message as indicated.

11. Magnetic Holder:
a. Openings requiring electrically controlled door holding magnets shall be equipped with units, which are fail-safe and hold until current is interrupted. Provide holders with through bolt attachment for door-mounted armatures.
b. Openings where vertical rod exit devices are used, furnish Rixson FM993 wall mounted magnetic holder. Holder is to be furnished "less release button" and furnished with a recessed, key cylinder operated wall mounted key switch similar to Locknetics 653. Keyed cylinder shall be interfaced with school master key system. Magnetic holders shall be interfaced with Fire/Life Safety Systems.

12. Overhead Stops and Holders:
a. Overhead stops and holders shall be certified to exceed six million (6,000,000) full load operating cycles by a recognized independent testing laboratory. Provide non-handed overhead stops and holders as listed in the hardware sets. Coordinate overhead holder and stop mounting with door closer to facilitate the optimum degree of door opening.
b. Manufacture all major metal components from brass, bronze or stainless steel to deter corrosion and to prevent stress related failures. Equip units with adjustable jamb bracket to allow adjustment after installation. Where required, furnish special templating application to prevent closer and overhead stop or holder from interfering with operation.

c. Install overhead stops and holders with one-piece sex bolts and machine screws. Do not install hold open devices on fire rated openings. Unless otherwise noted in hardware sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.

13. Protective Plates:
    a. Provide manufacturers standard exposed fasteners for door trim units, kick plates, edge trim, push/pull plates and similar units; either machine screws of self-tapping screws.
    b. Fabricate protection plates, armor, kick or mop, not more than 2 inches less than door width on stop side and not more than 1 inch less than door width on pull side, and 1 inch less than the door width on double doors, by the height indicated. Size plates to provide clearance for bottom rail, grills, louvers and door lites.
        1) Protective plates shall be nominal 10-inches in height.
        2) Metal Plates: Stainless steel plates 0.050, US 18 Ga.

14. Door Stops:
    a. Furnish heavy duty wrought stainless steel base material, concave or convex wall stops, coincide with lock function, wherever door strikes wall unless otherwise noted in hardware sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
        1) Floor Stops: (Place at maximum swing and out of traffic flow, avoid trip hazards).

    b. Provide gray resilient rubber bumpers.

15. Electronic Security Hardware:
    a. Electric Power Transfer: Provide fully concealed, tamper proof, when door is in closed position. Units shall provide continuous protection for the enclosed wires, when doors are in the open position. Provide UL rated units for use in fire door and frame applications. Power transfers to be UL listed, rated Class 1, low voltage, at 24VDC, 2 amperes, 16/20 amperes maximum surge, two 18 gauge wire or ten 24 gauge wire leads, as required. Coordinate where openings exceed 180-degree door swing with other hardware items. Units shall be approximately 9 inches x 1-7/16 inches x 1-1/2 inches, with housings and fittings pressure cast, zinc dichromate steel. Exposed door loop and electric power hinge transfers will not be permitted.
    b. Electrical Exit Devices: Manufacturer units in accordance with U.S. domestic and international standards for NFPA 101, Special Locking Arrangement. Provide only UL listed "A" Controlled Exit Panic Device for use on Accident Hazard or Fire Exit Hardware applications. Electrically actuated devices shall retract latchbolts instantly without delay for momentary unlocking or for extended periods of time. Solenoids shall be continuous duty, 24 volt, direct current, and 16.0-amp inrush. Devices shall be UL approved for Class II circuit applications.
        1) Door and frame manufacturer shall provide a concealed channel within the door between the electrified hinge and the locking mechanism.

c. Electric exit devices shall be operated by solenoid-activated latchbolts, which can be opened momentary, or for prolonged periods of time. Fail safe design, interruption of power, device returns latch bolt to the locked position. Devices to be connected direct to security consoles or may be used as a stand-alone alarm station. Devices shall be equipped with a request to exit switch (RX), to detect attempts to exit.

d. Fire Alarm Input: Building fire/life safety alarm system upon activation shall immediately disable alarmed devices permitting unrestricted emergency egress from area.

e. Proximity Card Reader: Furnish S5395 series, universal compatibility with all HID cards. Readers made with Polycarbonate UL 94 enclosure and shall mount directly to a single gang electrical box. Read ranges up to 5.5-inches and shall have over 137 billion unique codes.

f. Reader Controller: Model SRCNX shall be capable of configuring communication through networked, dial-up modem and communicate via RS485 to locking systems. Controller shall be furnished with flashable firmware, to keep board memory intact in case of power failure.

g. Enclosure shall be approximately 20-inches high x 20-inches wide x 4-inches deep with key lockable door. Power requirements shall be 16 VAC at 4 Amps or 24 volts at 4 Amps.
   1) Furnish one each Lantronix model UDS-1100 external device with AL175UL power supply and NP712FR battery back up system.
   2) Deliver proximity card reader, reader controller and accessories to Cherry Creek Operations & Maintenance Department.

h. Regulated Power Supply: Provide only UL listed, class 2-power supply, regulated and rectified to meet electrical security hardware current requirements. Install in a secured location adjacent to the security device. Equip with hinged panel and keyed lock. Enclosure shall be constructed of 19 gauge, prime coat gray steel, approximately 10 inches high, 12-1/2 inches wide, 5 inches deep, with (5) 1/2-inch by 3/4-inch knockout holes for conduit connection. Provide units with terminal blocks to accept up to 14-gauge wire. Regulated power output to be field selectable for either 24VDC at 2-ampere continuous, 16.0 amperes surge for 300 milliseconds or 12VDC at 4 ampere with power input 240VAC at 0.5 ampere, capable of providing power to two security devices.
   1) Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

i. Key Switches: Provide keyed cylinder switch, capable of accepting specified security cylinders, to provide means of arming, disarming or resetting devices. Switches shall allow key removal when either in the armed or disarmed position. Provide indicator lamps to allow visual status of security device. Security key switch shall be equipped with 24VDC solid state (SCA) alarm circuit containing a monitored NO contact input and NO alarm output, reset by activation of the key switch. Furnish 2-3/4-inches x 4-1/2-inches; tamper resistant back box with 1/2-inch knockouts for access to switch assemblies.

j. Door position indicator switches (DPIS) shall be recessed, UL approved for wood or metal fire door applications. Switches shall be recessed types for wood or metal door applications. Furnish magnetic housings, which can accommodate a variety of doors with channel widths.

k. Junction box: Provide surface mounted, hinged door with twist turn lock, junction box with 20 position terminal strip to accept 12 to 24 gauge wire. Units are to be approximately 10-inches high, 10-inches wide and 6-inches deep, with 6 heavy gauge steel, 3/4-inch knock outs, top, bottom, right and left side panels and back.
   1) Key locks for power supplies and junction boxes shall be keyed alike.

l. Wiring and Riser Diagrams: Supplier shall furnish to the General Contractor, electrical wiring and riser diagrams for low voltage security equipment specified in this Section. Provide elevation drawings indicating door numbers, associated electronic security equipment such as power supplies and interconnections between door system components, control wiring for electric locks, indicator signal lights and sounding devices which are contained in the approved hardware Submittals. Elevations shall indicate standard electrical enclosures detailing the manufacturer's space and attaching requirements.

m. Testing and Acceptance: General Contractor shall provide as part of the system start-up responsibilities, a complete data base with respect to electro-mechanical security hardware items functions and features. Testing shall include, but is not necessarily limited to, demonstration in the operational use of all electronic security hardware. Electrical circuits for each locking system opening shall be tested by the representative of the security hardware supplier and shall be certified as having compatible voltage, protection against overload and duty cycle capability consistent with the operation and installation.

n. Emergency Electrical Power Support: Refer to Electrical

o. Wire and Cable: Refer to Electrical.

p. Fire Alarm Systems: Refer to Electrical.

16. Thresholds, Weatherstripping and Seals:

a. Provide continuous seal at jambs and heads and at door bottom. Where specified, provide threshold type with silicone gasket. Smoke, or sound seals shall be rated in accordance with surrounding wall rating respective to sound or fire rating or as required by code. Unless otherwise indicated, provide metal threshold units of type, size and profile as shown or scheduled. Provide noncorrosive fasteners for exterior and interior applications.

b. Extruded aluminum with color anodized finish as selected by Architect from manufacturers standard color range; 0.062-inch minimum thickness of main walls and flanges. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

c. Nylon brush filament weather stripping, shall be wrapped around a core wire, locked in a metal spline and encased in an anodized aluminum flange for attachment. Nylon shall remain pliable within a temperature range of 400 degrees F to minimum -40 degrees F below zero. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

d. Fire-rated Doors, Resilient Seals: UL10C/UBC-7-2 compliant. Coordinate with selected door manufacturers and selected frame manufacturer's requirements. Where rigid housed resilient seals are scheduled in this section and the selected door manufacturer only requires an adhesive mounted resilient seal, furnish rigid housed seal at minimum, or both the rigid housed seal and the adhesive applied seal if necessary to fulfill door manufacturer's requirement. Adhesive applied seal alone is deemed insufficient for this project where rigid housed seals are scheduled.

e. Fire-rated Doors, Intumescent Seals: Furnish fire-labeled opening assembly complete and in full compliance with UL10C/UBC-7-2. Furnished by selected door manufacturer, these seals vary in requirement by door type and door manufacture.
   1) Adhesive applied intumescent strips are not acceptable, use concealed-in-door-edge type or kerfed-in-frame type. Careful coordination required.

f. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

17. Hardware Finishes:
   a. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or locksets).
   b. Provide quality of finish, including thickness of plating or coating (if any}, composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
   c. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
   d. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.
      1) Satin Chromium Plated, Clear Powder Coated: US26D/ANSI 626, ANSI 652.
      2) Brushed Stainless Steel, no coating: US32D/ANSI 630.
      3) Powder Coated Aluminum finish: ANSI 689.
      4) Thresholds and Weatherseal: Thresholds, mill aluminum finish. Weatherseal, clear anodized aluminum finish.

18. Installation:
   a. Preinstallation conference shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturer's representatives. A separate preinstallation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.

b. Pneumatic Operator Installation:
   1) Install pneumatic operated low energy automatic operators, pneumatic tubing, electro/pneumatic control boxes and electronic or radio frequency activated actuators in accordance with manufacturers suggested installation instructions. Interface with Division 28 Sections "Fire Alarm System" and "Access Control System".

c. Electronic Security Hardware Installation:
   1) Install electromechanical security exit devices, electric strikes, magnetic locks, key switches, power transfers, power supplies, junction boxes, door position switches, request for exit and motion detectors in accordance with manufacturers suggested installation instructions and practices. Interface with Division 28 Sections "Fire Alarm System" and "Access Control System".

d. Builder's Hardware Installation:
   1) Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

e. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
   1) Exit device touch bar height, center line to finished floor: 39-13/16-inches at center. Center exit devices on mid-rail of doors.
   2) Lever locksets height to, centerline to finished floor: 38-inches at center.
   3) ICC/ANSI A117. 1 – Accessible and Usable Buildings and Facilities.

19. Field Quality Control:
   a. Architectural Hardware Consultant: Architect will engage a qualified Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
   b. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

20. Adjusting, Cleaning, and Demonstrating:
    a. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
        1) Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

    b. Clean adjacent surfaces soiled by hardware installation.
    c. Manufacturer's representatives shall Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes. Allow 3 eight-hour training classes for mechanical locksets, exit devices and door closer. Allow 3 eight-hour training classes for electronic locksets and electronic security products.
    d. Six-Month Adjustment: Architectural Hardware Consultant to provide letter of certification to Architect that approximately 6 months after substantial completion, Consultant and installer will visit Project with representatives of the manufacturers of the locking devices and door closers to accomplish following:
        1) Re-adjust hardware.
        2) Evaluate maintenance procedures and recommend changes or additions. Instruct Owner's personnel in operation and maintenance or hardware and systems.
        3) Identify items that have deteriorated or failed.
        4) Architectural Hardware Consultant shall submit written report identifying problems and likely future problems.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products - Finish Hardware:
    1. Butts and Hinges:
        a. Ives Hinges 3CB1 3CB1HW
        b. McKinney Hinge: TA714 TA786
        c. Stanley Hinge: CB1900 CB1901

    2. Key Control System:
        a. Schlage Lock: Patent Protected Everest/Primus D Series
        b. Medeco Lock: Patent Protected Biaxial System

    3. Locksets, Latchsets and Deadbolts:
        a. Schlage Lock: ND Series Rhodes (RHO) Lever Design

4. Exit Devices:
   a. Von Duprin: 99 Series with 992L lever Trim

5. Door Closers:
   a. LCN: 4110-MC-EDA-AVB 4010-MC.

6. Low Energy Automatic Operators:
   a. LCN: 4840 Series

7. Magnetic Holders:
   a. Rixson: Model 993 (Thru-Bolted)
   b. LCN: SEM 7890 Series (Thru-Bolted)

8. Overhead Stops and Holders:
   a. Glynn Johnson 90 100 ADJ Series

9. Protective Plates:
   a. Ives 8400 (0.050-inches)
   b. Rockwood K1050 18 Gauge (0.050-inches)
   c. Triangle Brass K0050 18 Gauge (0.050-inches)

10. Door Stops:

a.	Ives:	WS406	FS495	470	436/438
b.	Rockwood:	407/408	494	455	440/441
c.	Triangle Brass:	W1274CCS	1254	1245	1210/1212

11. Door Stripping, Seals and Threshold:

a.	Pemko	272A	45041CNB	18041CNB	3452CNB	S88D
b.	National Guard	613A	A626A	600A	C627A	5050B

12. Miscellaneous Hardware Items:

a.	Site Master CD	SM01-287 (Network Version)		SCH
b.	Key Cabinet	AWC350	TEL	
c.	Knox Box	R3200	BLK	KNO
d.	Extra Cards (25) Cards	SCE		

Confirm with local authority Knox Box type and function.

B. Acceptable Public Safety Key Box:
   1. Provide one (1) Model 3200R Public Safety Key Box, fully recessed type, as manufactured by Knox-Box Company: www.knoxbox.com.

08 80 00 – GLAZING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Glass and glazing.
   2. Glazing materials.
   3. Display case sliding window system, shelves, and shelf hardware.
   4. Unframed mirrors.

B. Referenced Standards/Minimum Criteria:
   1. Comply with published standards of Flat Glass Marketing Association, latest edition, and all applicable manufacturer's recommendations.
   2. Regulatory Requirements: UL Classification is required for glass in rated doors/frames.
   3. Insulated Glass: Units shall be double sealed, single seal is not acceptable. Insulated glass units shall meet performance requirements of ASTM E774 (Class CBA). Insulating glass units shall be manufactured by member of Insulating Glass Certification Council (IGCC) or Sealed Insulating Glass Manufacturing Association (SIGMA).
   4. Insulated glass units in vertical application shall have ten (10) year written warranty against seal failure. Insulated glass units in sloped glazing shall have five (5) year written warranty against seal failure.

C. Submittals Required:
   1. Product data.
   2. Samples of each glass type (12- x 12-inches) and 12-inch long samples of glazing gaskets
   3. Samples of warranty.

D. Restrictions/Critical Criteria:
   1. Architect shall size glazing to facilitate replacement (5' x 7' maximum size). Larger sizes to be approved by the School District.
   2. Insulating glass is mandatory for exterior applications and tinted or low "E" glass (higher shading coefficient) is preferred over clear glass or reflective glass.
   3. Provide tempered or laminated safety glass in areas as required by the IBC. The School District prefers to use laminated safety glass.
   4. Insulating glass shall be factory double sealed units with 1/2-inch minimum air space.
   5. Wire glass: Not permitted.
   6. Allowable Tolerances: Maintain minimum glazing tolerance between glass faces and frame or metal stops as recommended by the Flat Glass Marketing Association. For 1/4-inch thick glass, maintain 1/8-inch clearance between glass face and metal stops.
   7. Labels: Every individual piece of glass shall bear a label designating type, thickness and quality. Do not remove labels until inspected by Architect.
   8. Glazing Tape: Closed cell, self-adhering, non-extruded PVC foam per glass manufacturer's recommendations.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Insulated Glass Units:
   1. PPG Industries, Inc. (now Vitro Glass): www.vitroglazings.com.
   2. Oldcastle Building Envelope: www.obe.com.
   3. Guardian Industries Corp. www.guardianglass.com.
   4. General Glass Corporation: www.generalglasscorp.com.
   5. Viracon: www.viracon.com.
   6. HPG -Hyperformance Glass Products: www.hyperformanceglass.com
   7. AGC Glass North America: www.agcglass.com.
   8. Approved substitute.

B. Acceptable Manufacturers - Spandrel Glass:
   1. Virginia Glass Products: www.va-glass.com.
   2. PPG Industries, Inc. (now Vitro Glass): www.vitroglazings.com.
   3. General Glass Corporation: www.generalglasscorp.com.
   4. Viracon: www.viracon.com.
   5. Guardian Industries Corp. www.guardianglass.com.
   6. HPG Hyperformance Glass Products: www.hyperformanceglass.com
   7. Approved substitute.

C. Acceptable Manufacturers - Tempered Glass:
   1. General Glass Corporation: www.generalglasscorp.com.
   2. Guardian Industries Corp. www.guardianglass.com.
   3. PPG Industries, Inc. (now Vitro Glass): www.vitroglazings.com.
   4. AGC Glass North America: www.agcglass.com.
   5. HPG Hyperformance Glass Products: www.hyperformanceglass.com.
   6. Viracon: www.viracon.com.
   7. Approved substitute.

D. Acceptable Manufacturers - Ceramic Laminated Glass:
   1. Viracon: www.viracon.com.
   2. Northwestern Industries, Inc. www.nwiglass.com.
   3. Guardian Industries Corp. www.guardianglass.com.
   4. PPG Industries (now Vitro Glass): www.vitroglazings.com.
   5. AGC Glass North America: www.agcglass.com.
   6. HPG - Hyperformance Glass Products: www.hyperformanceglass.com.
   7. Approved substitute.

E. Acceptable Manufacturers – Fire-Rated Glass:
   1. Technical Glass Products: www.fireglass.com.
   2. Vetrotech Division of Saint-Gobain: www.vetrotech.com
   3. Approved substitute

F. Acceptable Manufacturers - Polycarbonate Plastic:
   1. GE Plastics: www.ge.com.
   2. Makrolon Plastics: www.professionalplastics.com.
   3. Approved substitute.

G. Acceptable Display Cases and Sliding Glass Window System (middle schools and high schools):
   1. Shelves: 1/4– inch thickness clear tempered glass. Grind all edges smooth.
   2. Shelf Hardware: Knape & Vogt (K&V) No. 87 standards and No. 187LL brackets with No. 210, 211, 212 rests and No. 129 RUB cushions.
   3. Sliding Glass Window System (Large Opening): Kawneer 1010 Sliding Mall Front or approved substitute. Aluminum extrusions shall be 6063-T5 alloy and temper. System shall be complete with ball bearing casters, hook bolt lock, flush face pull, track, and frame components. Provide master keyable cylinder. For smaller openings use K&V complete system assembly.

H. Acceptable Mirrors:
   1. Toilet Rooms and Home Economics: 1/4-inch thickness mirror glazing quality polished plate with polished edges.
   2. Weight Room: 1/4-inch thickness tempered glass or Rohn & Haas Pexiglass Mirror. Provide safety backing as manufactured by C.R. Lawrence Co. or approved substitute between the mirror and the plywood substrate.

08 84 00 – DECORATIVE RESIN PANELS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Plastic glazing panels used for the following:
      a. Partitions.
      b. Wall Cladding.

B. Referenced Standards/Minimum Criteria:
   1. Sheet minimum performance attributes:
      a. Flame spread and Smoke developed testing (ASTM E 84): Material must be able to meet a level of Class A (Flame spread less than 25 and smoke less than 450) at thickness of 1-inch.
      b. Room Corner Burn Test (NFPA 286): Material must meet Class A criteria at 1/4-inch thickness as described by the International Building Code.
      c. Impact strength: Minimum impact strength test as measured by ASTM D 3763 of 20 ft. lbs. (for durability, shipping, installation, and use).

C. Submittals Required:
   1. Product data.
      a. Include ASTM R84 test data for flame spread and smoke developed.
   2. Shop drawings.
   3. Samples for selection.
   4. Maintenance Data: Manufacturer's care and maintenance data, including care, repair, and cleaning instructions.

D. Restrictions/Critical Criteria:
   1. Engineered polyester resin:
      a. Sheet Size: Per design, maximum 4-feet x 10-feet.
      b. Thickness: As indicated.
      c. Interlayer Materials: As indicated compatible with polyesters and bonding process to create a monolithic sheet of material when complete.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. 3Form: www.3form.com.
   2. Approved substitute.

B. Hardware and Accessories:
   1. Provide manufacturer's hardware indicated, suitable for attaching materials indicated.
      a. Partition mount: Partition top and bottom channels.
      b. Wall mount: Directly adhered to wall with adhesive as recommended by manufacturer.

08 90 00 – LOUVERS AND VENTS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Exterior wall louvers not supplied by mechanical.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Louvers and vents should be tool-adjustable only. Manually adjustable units are not recommended.

PART 2 - PRODUCTS

A. Acceptable Manufacturers / Louvers and Dampers:
   1. Ruskin: www.ruskin.com.
   2. American Warming and Ventilating: www.awv.com.
   3. Greenheck: www.greenheck.com.
   4. Safe-Air Dowco: www.safeair-dowco.com.
   5. Arrow United Industries: www.arrowunited.com.
   6. United Enertech Louvers: www.unitedenertech.com.
   7. Approved substitute.

B. Acceptable Wall Louvers:
   1. Manufacturer and Type: American Warming and Ventilating or equal of other acceptable manufacturer. Louver shall be 16 gauge galvanized steel, formed stationary non-drainable louver, 4-inch deep frame with Kynar Resin Fluoropolymer finish. Provide all necessary accessories, braces, and supports. Provide galvanized steel bird screens finished to match louver at interior side of louvers.

END OF SECTION

DIVISION 09 - FINISHES

09 05 61 – COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

A. Summary - Section includes:
   1. This Section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
      a. Resilient tile and sheet.
      b. Broadloom carpet.
      c. Carpet tile.
   2. Removal of existing floor coverings.
   3. Preparation of new concrete floor slabs for installation of floor coverings.
   4. Testing of concrete floor slabs for moisture and alkalinity (pH).
   5. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.

B. Referenced Standards/Minimum Criteria:
   1. ASTM C109/C109M (2020) "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)".
   2. ASTM C472 (2014) "Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete".
   3. ASTM F710 (2019) "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring".
   4. ASTM F1869 (2016a) "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".
   5. Resilient Floor Covering Institute - Recommended Work Practices (2011): "Recommended Work Practices for Removal of Resilient Floor Coverings"

C. Submittals Required:
   1. Unit cost for remediation of existing floor conditions / application of vapor control topping in accordance with Division 01 Section "Unit Prices".
   2. Visual Observation Report: For existing floor coverings to be removed.
   3. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
      a. Moisture and alkalinity (pH) limits and test methods.
      b. Manufacturer's required bond/compatibility test procedure.
   4. Testing Agency's Report:
      a. Description of areas tested; include floor plans and photographs if helpful.
      b. Summary of conditions encountered.
      c. Moisture and alkalinity (pH) test reports.
      d. Copies of specified test methods.
      e. Recommendations for remediation of unsatisfactory surfaces.

D. Restrictions/Critical Criteria:
   1. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor. Contractor shall submit name of testing company to the Owner and Architect for approval prior to any testing.
   2. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
      a. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
      b. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   3. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
   4. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
      a. Thickness: As required for application and in accordance with manufacturer's installation instructions.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Ardex MC Rapid" by Ardex Americas: www.ardexamericas.com.
   2. Approved substitute.

B. Moisture Vapor Emission Testing:
   1. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   2. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   3. Test in accordance with ASTM F1869 and as follows.
   4. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 sq. m.) per 24 hours.
   5. Report: Report the information required by the test method.

C. Alkalinity Testing:
   1. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   2. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience:
      a. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
      b. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
      c. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

09 21 13 – PLASTER ASSEMBLIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Furring and lathing.
   2. Keene's cement plaster for interior ceilings.

B. Referenced Standards/Minimum Criteria:
   1. "Specifications for Metal Lathing and Furring" as prepared by the Metal Lath Association, current edition.
   2. ANSI Designation A42.3 "Lathing and Furring for Portland Cement and Portland Cement-Lime Plastering, Exterior (Stucco) and Interior''.
   3. ANSI Designation A42.4 "Portland Cement and Portland Cement-Lime Plastering, Exterior (Stucco) and Interior''.
   4. Standard Specification for Application of Portland Cement- Based Plaster: ASTM C926.
   5. Standard Specification for Installation of Lathing and Furring for Portland Cement - Based Plaster: ASTM C1063-19a "Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster".

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Architect to verify with School District locations to receive plaster ceilings. Typically, this type of ceiling is used in shower/locker rooms.
   2. Construct plastered ceilings of metal lath and plaster on suspended system per referenced standards and manufacturer's recommendations.
   3. Apply two (2) base coats of plaster and one finish coat. Total thickness of system shall be not less than 7/8-inch including lath and plaster. Damp cure all coats of plaster. Cure scratch coat fora 48-hour period before brown coat is applied. Cure brown coat for 48 hours, allow to dry for five (5) days, then apply finish coat. Apply finish coat to a smooth sand finish with as little texture as possible.
   4. Casing Beads: In all places where plastered surfaces finish against concrete or other exposed surfaces install metal casing. Provide casing beads at plaster ceilings adjacent to masonry walls.
   5. Control Joints: At intervals not to exceed 10'-0" on center, install control joints across full width and height of plaster surface.

PART 2 - PRODUCTS

A. Acceptable Lathing Materials:
   1. Metal Lath: 3.4 lb. galvanized expanded metal diamond mesh lath conforming to ASTM C847-18 "Standard Specification for Metal Lath".
   2. Main Runner Channels: 1-1/2-inch, 16 gauge cold-rolled channels, black asphaltum painted.
   3. Cross Furring Channels: 3/4-inch, 16 gauge cold-rolled channels, black asphaltum painted.
   4. Hanger Wire: No. 9 gauge galvanized wire conforming to ASTM A641.
   5. Tie Wire: No 16 or No. 18 gauge galvanized wire conforming to ASTM A641.
   6. Corner Beads: Expanded corner bead.
   7. Casing Bead: USG No. 66 or equal of other acceptable manufacturer.
   8. Control Joints: USG No. 50 or 100, or equal of other acceptable manufacturer.
   9. Metal Reveals: Fry Reglet or equal.

B. Acceptable Plastering Materials:
   1. Gypsum Keene's Cement: Conform to ASTM C61-00 (2015) "Standard Specification for Gypsum Keene's Cement".
   2. Hydrated Lime: Conform to ASTM C207-18 "Standard Specification for Hydrated Lime for Masonry Purposes", Type S.
   3. Base Coat Aggregate: Clean natural or manufactured sand conforming to ASTM C897-15 (2020) "Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters" that is free from deleterious amount of loam, clay, salt, soluble salts, and organic matter.
   4. Finish Coat Aggregate: Fine silica sand conforming to ASTM C897 with 100% passing No. 8 sieve.

09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Gypsum board partitions.
   2. Gypsum board on non-structural steel studs.
   3. Acoustical insulation.
   4. Fiber-Reinforced gypsum board partitions.
   5. Water-Resistant gypsum board.
   6. Shaftwall system.
   7. Joint treatment and accessories.

B. Referenced Standards/Minimum Criteria:
   1. Comply with manufacturer's specifications and Gypsum Association Documents GA-216 "Recommended Specifications for Application and Finishing of Gypsum Board" and GA-214 "Levels of Gypsum Board Finish", latest edition.
   2. For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency and the "Fire Resistive Design Manual" published by the Gypsum Association.
   3. "Gypsum Construction Handbook'' published by United States Gypsum.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Architect to verify with School District appropriate locations for gypsum board partitions and fiber-reinforced gypsum board partitions. Typically walls in classrooms, offices and similar low impact areas may be gypsum board. Corridor walls in high schools and middle schools will be either masonry or fiber-reinforced gypsum board.
   2. All drywall studs to be installed at 16-inches on center (maximum) and shall be braced at the head per IBC requirements.
   3. Sound attenuation batt shall be installed in all stud walls enclosing occupied spaces (classrooms, offices, etc.).
   4. Apply vapor barrier over face of insulation and beneath gypsum board at exterior stud walls if requested by Owner. Cover joints of vapor barrier with pressure sensitive tape.
   5. Apply gypsum board panels vertically or horizontally upon manufacturer's recommendations to comply with fire-resistive construction, if required. Abutting ends and edges of panels shall occur over stud flanges or furring. Joints on opposite sides of partitions shall not occur over the same stud.
   6. Apply metal trim and corner bead according to manufacturer's recommendations at gypsum board edges which are exposed or abut other materials.
   7. Finish joints, trim, and fastener dimples as recommended by GA-216 and sand smooth to provide "Level 4" finish surface for finished exposed gypsum board partitions and walls. Provide GA-216 "Level 1" finish surface where concealed.

8. Install control joints in gypsum board partitions and walls in accordance with referenced Gypsum Assoc. Document. Runs between control joints shall not exceed 30'-0" on center.
9. Install full-height water-resistant boards on all walls behind and adjacent to plumbing fixtures. Install water-resistant boards within mechanical outside air intake shafts and within crawl space ventilation shafts.
10. Erect shaftwall system as recommended by manufacturer and as required to meet specified fire rating. Stud spacing shall not exceed16-inches on center. Use manufacturer's standard details for corners and wall junctions.
11. Install bottom of gypsum board panels 5/8-inch above concrete floor.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Gypsum Board and Accessories:
   1. Eagle Materials: www.eaglematerials.com.
   2. Georgia-Pacific Corporation: www.buildgp.com.
   3. Louisiana-Pacific Corporation: www.lpcorp.com.
   4. National Gypsum Company: www.nationalgypsum.com.
   5. Pabco Gypsum Co. www.pabcogypsum.com.
   6. Pittcon Industries: www.pittconindustries.com.
   7. United States Gypsum Company: www.usg.com.
   8. Approved substitute.

B. Acceptable Manufacturers - Fiber-reinforced Wall Board:
   1. National Gypsum Company: www.nationalgypsum.com.
   2. United States Gypsum Company: www.usg.com.
   3. Approved substitute.

C. Acceptable Manufacturers - Drywall Studs:
   1. CEMCO: www.cemcosteel.com.
   2. Clark-Western Metal Lath Company: www.westsidebmc.com.
   3. ClarkDietrich Building Systems: www.clarkdietrich.com.
   4. MarinoWare: www.marinoware.com.
   5. Studco US: www.studcosystems.com.
   6. United States Gypsum Company: www.usg.com.
   7. Other approved manufacturers.

D. Acceptable Drywall Studs and Related Materials:
   1. Drywall Studs: 25-gauge, 3-5/8-inch. Use 20-gauge studs both sides of hollow metal frames (double studs) and behind wall mounted shelving or cabinets and behind wall mounted T.V. monitors (double studs).
   2. Stud Runners: 25-gauge Metal Runner, 3-5/8-inch. Provide runners to accommodate other stud widths where required.
   3. Runner Channels: 1-1/2-inch, 16-gauge cold-rolled channels, black asphaltum painted.
   4. Furring Channels: 25-gauge metal furring channels
   5. Resilient Channels: Resilient furring channels.
   6. Stud Fasteners: Pan-head stud screws.

E. Acceptable Gypsum Board and Related Materials:
   1. Gypsum Board: USG "Sheetrock Firecode" (Type X), 5/8-inch thick, 48-inch wide, tapered edge boards (1-hour fire rated), or equal of other acceptable manufacturer in conformance with ASTM C36.
   2. Water-Resistant Gypsum Board: USG "Sheetrock Water-Resistant Firecode" (Type X), 5/8-inch thick, 48-inch wide tapered edge boards (1-hour fire rated), or equal of other acceptable manufacturer in conformance with ASTM C630
   3. Drywall Screws: USG "Type S" or "Type S-12" drywall screws or equal of other acceptable manufacturer. Use proper type for gauge of stud. Use proper length for panels to be fastened.
   4. Metal Trim: USG No. 200-B steel "L" trim or equal of other acceptable manufacturer.
   5. Joint Treatment: USG "Sheetrock Joint Tape", cross-fiber paper reinforcing tape, with USG "Sheetrock All Purpose Ready Mixed Joint Compound" or equal of other acceptable manufacturer.
   6. Adhesive: Ohio Sealants, Inc., "Formula #38 Adhesive" or equal of other acceptable manufacturer.
   7. Sound Insulating Batts: 3-inch thickness, unfaced fiberglass, widths to fit stud spacing.
   8. Control Joints: USG "No. 093" or equal of other acceptable manufacturer.
   9. Corner Bead: USG "No. 103" or equal of other acceptable manufacturer.
   10. Vapor Barrier: 6 mil thick polyethylene.
   11. Radius Corner Bead: Pittcon "Softforms" Model No. SO-9-075 or equal product manufactured by Fry Reglet, Phillips, or other acceptable manufacturer.

F. Acceptable fiber-reinforced gypsum board: National Gypsum "Hi-Impact Fiber-reinforced Gypsum Board" with fiberglass mesh reinforcing layer on backside of panels, or equal of other acceptable manufacturer. Boards shall be 48-inches wide with tapered edges, 5/8-inch thick, and 1-hour fire rated in accordance with ASTM E119 and ASTM E84.

G. Acceptable Shaftwall System: USG "Shaftwall System" or equal of other acceptable manufacturer. Provide fire-rated shaftwall construction. 3-1/8-inch total thickness, 1-hour rated.

H. Acceptable Compressible Gaskets: Norton #V-780, 1/8-inch foam tape or equal.

09 22 13 – GYPSUM BOARD CEILINGS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Gypsum board ceilings.
   2. Kitchen exhaust hood duct enclosures if required.

B. Referenced Standards/Minimum Criteria:
   1. Comply with manufacturer's specifications and Gypsum Association Documents GA-216 "Recommended Specifications for Application and Finishing of Gypsum Board" and GA-214 "Levels of Gypsum Board Finish", latest editions.
   2. For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency and the "Fire Resistive Design Manual" published by the Gypsum Association.
   3. "Gypsum Construction Handbook" published by United States Gypsum.
   4. Comply with ASTM C754 and ASTM C840 Standards.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Architect to verify with School District ceilings to be constructed with gypsum board. Typically, these ceilings are used in middle school/high school toilet rooms, and other similar rooms where durable non-absorbent materials are required.
   2. Install suspension system per referenced standards and manufacturer's instructions.
   3. Install gypsum board with long dimension parallel and centered on main tee runners. Fasten board to cross tees with screws spaced at 1-1/2-inch from side joints and 12-inches on center within field of board. Screws at end joints shall be spaced 1/2-inch from end of board. Screws in field shall be staggered on alternating sides of cross tee flanges. Fasten board to wall support angle at 12-inches on center. Stagger ends of boards minimum 4'-0".
   4. Apply metal trim, according to manufacturer's recommendations where gypsum board abuts walls or dissimilar materials.
   5. Finish joints, trim, and fastener dimples as recommended by manufacturer of tape-joint system and sand smooth to provide "Level 4" finish surface for gypsum board ceilings.
   6. Install kitchen exhaust hood duct enclosure with clearances, adhesive, fasteners, hangers and straps per manufacturer's recommendations, standard details, and conforming to UL fire rating requirements.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Gypsum Board:
   1. Eagle Materials: www.eaglematerials.com.
   2. Georgia-Pacific Corporation: www.buildgp.com.
   3. Louisiana-Pacific Corporation: www.lpcorp.com.
   4. National Gypsum Company: www.nationalgypsum.com.
   5. Pabco Gypsum Co. www.pabcogypsum.com.
   6. United States Gypsum Company: www.usg.com.
   7. Approved substitute.

B. Acceptable Products:
   1. Gypsum Board: USG "Sheetrock Firecode" (Type X) 5/8-inch thick, 48-inch wide boards with tapered edges (1 hour rated) or equal of other acceptable manufacturer in conformance with ASTM C36.
   2. Fasteners: USG "Type S Drywall Screws" or equal of other acceptable manufacturer.
   3. Metal Trim: USG No. 200-B steel "L" trim or equal of other acceptable manufacturer.
   4. Joint Treatment: USG Sheetrock Joint Tape": cross-fiber paper reinforcing tape, with USG "Sheetrock All Purpose Ready Mixed Joint Compound" or equal of other acceptable manufacturer.
   5. Kitchen Exhaust Hood Duct Enclosure: 2-1/4-inch thick "Super Fire Temp-L" by Johns-Manville, an inorganic, non-combustible, high-temperature insulation for fire protection applications. It can be used in systems operating up to 1800-deg F (982-deg C), made primarily of lime, silica and reinforcing fibers. Product is white, essentially dust-free, containing no asbestos, mercury or lead, and meeting or exceeding ASTM C656, Type II Grade 5. Provide cleanout access covers as required and recommended by manufacturer. Provide manufacturer's recommended adhesive and joint treatment.

C. Acceptable Manufacturers - Suspension System:
   1. "Fire Front 670 System" by Rockfon: www.rockfon.com.
   2. "Rigid X Drywall Suspension System" by USG: www.usg.com.
   3. Approved substitute.

D. Acceptable Products - Suspension System:
   1. 24" x 48" grid constructed of twelve (12) foot long heavy-duty galvanized main tee runners with nominal 1-inch wide exposed knurled free and 1-1/2-inch web height and four (4) foot long heavy-duty cross tees with nominal 1-3/8-inch wide exposed knurled face and 1-1/2-inch web height. Wall support angle shall be 26 gauge galvanized steel angle with 1-1/8-inch legs.
   2. Hanger Wire: No. 9 gauge galvanized wire.
   3. Tie Wire: No. 16 gauge galvanized wire.
   4. Cold-Rolled Channels: 12 gauge painted channels, 2-inches deep with 1-1/8-inch flanges.

09 25 13 – ACRYLIC THIN COAT STUCCO

PART 1 - GENERAL

A. Summary - Section includes:
   1. Acrylic Thin Coat Stucco System on Exterior Framed Walls.
   2. Lath.
   3. Air/Vapor Barrier.

B. Referenced Standards/Minimum Criteria:
   1. Qualifications: Applicator specializing in the installation of acrylic base coat and finish coat systems with a minimum five (5) years experience.
   2. Mock-Up: Construct a 4-foot x 4-foot sample panel using same materials and substrates required for project. Panel shall show color and workmanship of finish work. Do no proceed with work until sample is reviewed and approved by Architect. Maintain sample panel on project site for duration of project. Remove sample upon project completion. Include in Base Bid the cost to construct a maximum of two (2) sample panels.

C. Submittals Required:
   1. Product data.
   2. Samples - full range of colors.
   3. Maintenance data.

D. Restrictions/Critical Criteria:
   1. Allowable Tolerances: Maximum deviation from true plane of 1/8-inch in 5-feet as measured by straight edge placed at any location on surface.
   2. Single Source Responsibility: All stucco base and finish materials from a single manufacturing source or one that is approved by the manufacturer.
   3. Do not apply base coat when ambient temperature is forecast to be less than 40 deg F. within a 24-hour period following application.
   4. Areas where stucco system meets dissimilar materials or terminates shall have appropriate accessories and sealant installed. Control joints are required every 144 square feet maximum, at dissimilar construction, and at floor lines on multi-level construction. Length to width ratio of expansion joint layout shall not exceed 2:1. Supplementary control joints are required at penetrations through the system, i.e., above and below doors or windows.
   5. After preparation of substrate and installation of lath and accessories, apply stucco base coat with proper spray equipment or a stainless steel trowel to a minimum thickness of approximately 1/2-inch. Apply second coat, if necessary, to match the height of the trim accessories as soon as the first coat is firm enough to receive the second coat without physical damage. Alternatively, damp cure the first coat for 48 hours, then apply the second coat. Level the stucco surface with darby or stainless steel trowel to achieve a smooth, plumb surface. Damp cure by lightly fogging the installed area for at least 48 hours after the stucco takes initial set (usually within the first 1 to 4 hours after the installation). DO NOT INSTALL STUCCO DURING EXTREMELY HOT, DRY AND/OR WINDY CONDITIONS. Allow base coat application to completely dry before applying finish.

6. Apply finish coat primer to base coat not less than ten (10) days after completion of base coat. Apply at coverage using equipment as recommended by manufacturer.
7. Apply finish coat directly over the primed base coat. The finish coat shall be applied by spraying, rolling or troweling with a stainless steel trowel, depending on finish specified. Apply finish coat to approximately thickness of 1/8-inch to achieve full coverage.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Thin Coat Stucco:
   1. "Fastwall System" by El Rey Stucco, Inc. www.elrey.com, or comparable products by one of the following:
      a. Bonsal American (Amerimix): www.amerimix.com.
      b. Dryvit: www.dryvit.com.
      c. Omega Products: www.omega-products.com.
      d. Quikrete Construction Products: www.quikrete.com.
      e. Sto Corp. www.stocorp.com.
      f. Approved substitute.

B. Manufacturers - Air/Vapor Barrier:
   1. "Tyvek Stucco Wrap" by DuPont: www.dupont.com.
   2. Approved substitute.

09 28 00 – GYPSUM SHEATHING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Exterior gypsum sheathing.

B. Referenced Stands/Minimum Criteria:
   1. Product data/specifications.

C. Restrictions/Critical Criteria:
   1. Apply gypsum sheathing panels of maximum practical length with long dimensions at right angles to studs and fasten per manufacturer's recommendations for fire rating.
   2. Install gypsum sheathing under ridged roof insulation or under metal roofing as required for fire rating or roofing systems.
   3. Apply vapor barrier over sheathing as required by IBC.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. "DensGlass Gold" by Georgia-Pacific Corporation: www.buildgp.com.
   2. "Securock Glass Mat Sheathing" by United States Gypsum Company: www.usg.com.
   3. "GlasRoc" by CertainTeed: www.certainteed.com.
   4. Approved substitute.

B. Sheathing Panels:
   1. Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177:
      a. Thickness: 1/2-inch.
      b. Width: 4-feet.
      c. Length: Manufacturer's standard.
      d. Weight: 1.9 lb/sq. ft.
      e. Edges: Square.
      f. Surfacing: Fiberglass mat on face, back, and long edges.

   2. Fire-Rated Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177, Type X:
      a. Thickness: 5/8-inch.
      b. Width: 4-feet.
      c. Length: Manufacturer's standard.
      d. Weight: 2.5 lb/sq. ft.
      e. Edges: Square.
      f. Surfacing: Fiberglass mat on face, back, and long edges.

C. Fasteners: Bugle or wafer head self-tapping rust resistant screws approved by the manufacturer.

09 30 00 – TILING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Ceramic wall tile and base.
   2. Floor tile, base, and stair nosings.

B. Referenced Standards/Minimum Criteria:
   1. Ceramic Tile - Latex Portland Cement Thin Set Installation: ANSI A108.5 and A118 and A136.
   2. Tile Council of North America "Handbook for Ceramic, Glass, and Stone Tile Installation" (current edition).

C. Submittals Required:
   1. Product data.
   2. Schedule of TCNA installation methods to be used.
   3. Color options and sample of tile and grout.

D. Restrictions/Critical Criteria:
1. Verify with School District acceptable locations for using ceramic tile, porcelain tile, and quarry tile.
2. Ceramic Tile Walls - Thin Set Installation: Install, grout, clean, protect, and cure in conformance with referenced ANSI Standards and TCNA Installation Methods.
3. Quarry or Porcelain Tile Floors, Base, and Stair Nosings: Thin Set Installation: Install, grout, clean, protect, and cure in accordance with ANSI Standards. Refer to floor plan drawings for tile layout. Maintain 1/8-inch wide grout joints in quarry tile floor, base, and stair nosings.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Ceramic and Porcelain Tile:
1. American Olean Company: www.americanolean.com.
2. Crossville Ceramics: www.crossvilleinc.com.
3. Dal-Tile Corporation: www.daltile.com.
4. Florida Tile: www.floridatile.com.
5. Graniti Fiandre: www.granitifiandre.com.
6. Monarch Tile Manufacturing, Inc. Florence, AL.
7. United States Ceramic Tile Company: www.usctco.com.
8. Approved substitute

B. Acceptable Manufacturers - Quarry Floor Tile and Base:
1. American Olean Company: www.americanolean.com.
2. Dal-Tile Corporation: www.daltile.com.
3. Quarry Tile Co. www.quarrytile.com.
4. Summitville Tiles, Inc. www.summitville.com.
5. Approved substitute.

C. Acceptable Manufacturers - Tile Mortar and Grout:
1. Bostik: www.bostik.com.
2. C-Cure: www.c-cure.com.
3. Custom Building Products: www.custombuildingproducts.com.
4. Laticrete: www.laticrete.com.
5. Mapei: www.mapei.com.
6. TEC Specialty Products: www.tecspecialty.com.
7. Approved substitute.

A. Acceptable Products:
1. Ceramic Wall Tile: 4-1/4- x 4-1/4-inches x 5/16-inch thick Dal-Tile "Semi-Gloss", or equal of other acceptable manufacturer.
2. Quarry Floor Tile, Base, and Stair Nosings:
   a. Floor Tile: 8-inches by 8-inches by 1/2-inch thick.
   b. Base: 5- x 6-inches x 1/2-inch thick coved base with bullnose edges and corners.
   c. Stair Nosings: 4- x 8-inches x 1/2-inch thick with bullnose edge and abrasive texture.

3. Porcelain Tile:
   a. Floor tile: 12- x 12-inches x 5/16-inch thick
   b. Stair treads: 8- x 8-inches x 5/16-inch thick

4. Accessory Pieces: Provide bullnose pieces at all outside corners or exposed edges, typical of each tile types specified.

B. Acceptable Setting and Grouting Materials - Thin Set Installation - Floor and Walls (Latex Portland Cement):
   1. Bond Coat: Laticrete "211 Crete Filler Powder" with Laticrete "4237 Latex Thin-Set Mortar Additive", or Bostik "Tile-Mate Floor & Wall" or "Tile-Mate Premium" with Bostik "425 Multi-purpose Acrylic Latex Grout Admixture" or mortar applicable to tile and TCNA tile installation method.
   2. Grout: Laticrete "Grout and Joint Filler" with Laticrete "1776 Grout Admix Plus" or Bostik "Ceramic Tile Grout/Joint Filler" with Bostik "425 Multi-purpose Acrylic Latex Grout Admixture" (for standard grout) or Bostik "1900 Epoxy Modified Grout & Mortar Admixture" (for epoxy grout), or mortar applicable to tile and TCNA tile installation method

09 51 23 – ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Suspended acoustical grid and lay-in panels.
   2. Light fixture and cabinet heater protection.

B. Referenced Standards/Minimum Criteria:
   1. Install acoustical materials in accordance with the requirements listed for job conditions in the current Acoustical Materials Association Bulletins.

C. Submittals Required:
   1. Product data.
   2. Color options, samples of tile, and ceiling grid.

D. Restrictions/Critical Criteria:
   1. Acoustical: lay-in panels shall have a minimum noise reduction coefficient (NRC) rating of 0.55 in accordance with ASTM C423. The completed suspended acoustical grid ceiling system shall have a Ceiling Attenuation Class (CAC) rating of not less than 35 in accordance with ASTM E1414.
   2. Fire: Panels and suspension system shall be Class A listed and labeled for minimum of one- hour fire rating where indicated. The completed fire-rated assembly shall comply with one-hour fire resistance ratings test conducted by Underwriter's Laboratories, Inc. or other recognized testing laboratory.

3. Install ceiling grid suspended from structure per manufacturer's recommendations and referenced standards.
4. Use vinyl wrapped gypsum drywall panels in kitchen areas and, with School District approval, toilet rooms in elementary schools.
5. Where fire rated roof/ceiling assembly is required in elementary school gymnasiums, fire rated lay-in ceiling panels shall be "rock faced" impaction resistant panels held firm in grid with impact deceleration clips.
6. For light fixture and cabinet heater protection, install box, tent, or flat cover over fixture and cabinet unit heater for fire-rated protection applicable to the assembly being provided.
7. Extra Materials: Provide the Owner at the completion of the job, two full packages of each type of acoustical ceiling panel used.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Armstrong World Industries: www.armstrongceilings.com.
   2. Certainteed: www.certainteed.com.
   3. Rockfon Products: www.rockfon.com.
   4. United States Gypsum Company: www.usg.com.
   5. Approved substitute.

B. Acceptable Manufacturers - Suspension Systems:
   1. Armstrong World Industries: www.armstrongceilings.com.
   2. Chicago Metallic: www.rockfon.com.
   3. United States Gypsum Company: www.usg.com.
   4. Approved substitute

C. Acceptable Acoustical Ceiling System, Typical:
   1. 24- x 48-inch or 24- x 24-inch T and T suspension system with flush lay-in panels (1 hour rated and non-rated).

D. Acceptable Acoustical Ceiling System - Elementary Gymnasiums:
   1. 24- x 24-inch T and T suspension system with impact deceleration clips and impact resistant lay-in panels by USG or approved substitute.

E. Acceptable Acoustical Ceiling System - Swimming Pools:
   1. 24- x 48-inch T and T suspension system with flush lay-in panels. Double-web aluminum grid system, Armstrong "AL Prelude Plus" system or equal of other acceptable manufacturer. Panels to be Armstrong "Ceramaguard RH-100" (ceramic and mineral fiber composite with factory-applied vinyl plastic paint - perforated pattern) or equal of other acceptable manufacturer having specified NRG rating.

09 64 00 – WOOD FLOORING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Fir main stage area in secondary schools.
   2. Oak forestage area in secondary schools.
   3. Maple gym flooring.

B. Referenced Standards/Minimum Criteria:
   1. Oak flooring shall comply with grading rules of the National Oak Floor Manufacturer's Association: www.nwfa.org.
   2. Maple flooring shall comply with grading rules of the Maple Flooring Manufacturer's Association (MFMA): www.maplefloor.org.
   3. Colorado High School Activities Association (CHSAA): www.chsaa.org for game court layout requirements.

C. Submittals Required:
   1. Product data.
   2. Shop drawings layout and artwork for court markings in gyms.
   3. Samples of flooring material.
   4. Finish and paint schedule.

D. Restrictions/Critical Criteria:
   1. Wood flooring shall be installed and finished by a Contractor/Installer with at least five (5) years experience in the installation and finishing of wood floors.
   2. Flooring bundles shall be opened seven (7) days prior to installation, under proper and constant ventilation. The temperature of the room shall not be more than 70 degrees F. nor less than 50 degrees F. Final determination as to acclimation of flooring materials shall be made by the flooring contractor/installer.
   3. Provide installer's warranty against defective workmanship covering a period of two (2) years, commencing on the date of Certification of Substantial Completion.
   4. Cover entire concrete slab with two (2) layers of vapor barrier, lapping joints a minimum of 6-inches and continuously sealing joints and perimeter with tape. Lay second layer 90 degrees to first. Tape around all penetrations. Patch or otherwise repair any damage or tom vapor barrier. Should the Geotechnical Engineer's report include the presence of moisture below the slab, additional precautions shall be taken to restrict the transfer of moisture through the slab and into the wood flooring. These precautions may include the introduction of a waterproof membrane either below or above the slab as recommended by the Geotechnical Engineer and flooring manufacturer.
   5. Install and finish wood flooring per manufacturer's recommendations and referenced standards.

PART 2 - PRODUCTS

A. Acceptable Products/Materials – Stage Areas:
   1. Sleepers: 2 x 3 Hem or Douglas Fir, Standard Grade or Better, pressure-treated or dip treated in liquid preservative.
   2. Subfloor: 4-foot x 8-foot APA rated exterior grade plywood sheathing, Exposure 1, 1/2-inch thickness.
   3. Flooring:
      a. Fir: 33/32" x 2-1/4" Grade B and Better, vertical grain, tongue and groove, Douglas Fir.
      b. Oak: 33/32" x 2-1/4" select quarter sawn, tongue and groove, end matched, kiln-dried, Red Oak. Lengths of 2-feet and up, with average length 4-1/4-feet.
      c. Flooring shall be treated with "Woodlife F Preservative". Each bundle shall be stamped with the official treating plant number and a certification attesting to treatment shall be furnished with each shipment. Submit original certificate(s) to Architect.
   4. Vapor Barrier: 6 mil polyethylene.
   5. Finish Materials:
      a. Stain: Pratt & Lambert or equal penetrating sealer with tonetic wood stain added.
      b. Sealer: Pratt & Lambert or equal penetrating clear sealer.
   6. Perimeter Vented Base: 3- x 4-inch vented vinyl or rubber base with premolded outside corners, standard of flooring manufacturer.

B. Acceptable Flooring Manufacturers and Systems – Maple Gym Floors:
   1. "Permacushion Panel System" by Robbins Sports Surfaces: www.robbinsfloor.com.
   2. "Duracushion II" by Connor Sports: www.connorsports.com.
   3. Approved substitute

C. Acceptable Products – Maple Gym Floors:
   1. Vapor/Isolation Barrier: 6 mil polyethylene.
   2. Subfloor: 2 layers 1/2-inch thick x 4' x 8' APA rated plywood sheathing, Exposure 1.
   3. Cushion Pads: 5/8-inch thick x 2-1/4- x 3-inch PVC pads, standard of flooring manufacturer.
   4. Flooring:
      a. Maple Flooring: 33/32-inch thick by 2-1/4-inches wide, Grade 3, tongue and groove, end matched, kiln-dried, Northern Hard Maple flooring, graded in accordance with MFMA standards. Flooring shall be grade marked and stamped by an MFMA member manufacturer.
   5. Perimeter Vented Base: 3- x 4-inch vented vinyl or rubber base with premolded outside corners, standard of flooring manufacturer.
   6. Finish Materials (VOC Compliant only):
      a. Shall be approved by the Maple Flooring Manufacturers Association and meet all EPA requirements.
      b. Scrubbing Agent: Hillyard Super Shine-All.

c. Stain: Pratt & Lambert or equal penetrating sealer with tonetic wood stain added.
d. Sealer: Pratt & Lambert or equal penetrating clear sealer.
e. Line Paint: Hillyard Gym Marking Paint: www.hillyard.com.
f. Finish: Hillyard "Tip-Off Waterborne Finish": www.hillyard.com.
g. See Division 09 Section "Painting".

09 65 00 – RESILIENT FLOORING

PART 1 - GENERAL

A. Summary - Section includes:
1. Vinyl composition tile.
2. Solid vinyl floor tile (LVT).
3. Sheet vinyl flooring.
4. Weight room flooring.
5. Rubber base.
6. Vinyl edging.
7. Stair treads and risers.

B. Referenced Standards/Minimum Criteria:
1. None.

C. Submittals Required:
1. Product data.
2. Color options/samples.

D. Restrictions/Critical Criteria:
1. Provide one (1) year warranty from each flooring system manufacturer, agreeing to repair or replace the resilient flooring systems used on the project (including finish materials and adhesives) if system fails to perform (i.e., loss of adhesion, cupping, cracking, separation of joints, displacement, etc.) due to failure of materials, including without limitation, failure of adhesives. Specifically, the adhesives shall be warranted against failure when used on a substrate exhibiting a maximum moisture content up to and including 6.0 lbs. per 1,000 square feet in a 24 hour period for vinyl composition and rubber tile and up to and including 3.0 lbs. Per 1,000 square feet in a 24 hour period for sheet vinyl flooring when tested at any time during the warranty period, using the RMA Qualitative/Quantitative test method.

E. Surface Preparation: Level uneven concrete floor joints or other irregularities by filling with latex type underlayment. Sand leveled areas to provide a completely level surface. Any required grinding or chipping of concrete will be at the expense of the Contractor. Prime concrete floors as recommended by the manufacturer of the flooring material. Verify compatibility of the floor covering mastic with previously applied curing compound.

F. Complete installation of sheet vinyl flooring in strict accordance with the recommendations of and specifications of the manufacturer. Form 6-inch high integral base where scheduled using wood or plastic cove strip and metal binding strip at top edge. Securely attach top edge metal binding strip to wall surface using mechanical fasteners; adhesive is not acceptable. Apply sealant at top edge of integral base. Use largest sheets possible to minimize joints. Joints shall be chemically welded.

G. Extra Materials: Provide the Owner the following items:
1. Resilient flooring: 1% of each color and type used.
2. Two (2) cases of rubber base.
3. One (1) gallon of each type of adhesive used.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Vinyl Composition Tile:
1. Armstrong: www.armstrongflooring.com.
2. Congoleum: www.congoleum.com.
3. Tarkett Inc. www.commercial.tarkett.com.
4. Approved substitute

B. Acceptable Products - Vinyl Composition Tile:
1. Armstrong "Standard Excelon Imperial Texture" or equal products of other acceptable manufacturer.
2. Size: 12-inches by 12-inches, 1/8-inch thick.

C. Acceptable Manufacturers - Solid Vinyl Floor Tile (LVT):
1. Amtico: www.amtico.com.
2. Armstrong: www.armstrongflooring.com.
3. Johnsonite Rubber Company: www.commercial.tarkett.com.
4. Mannington Commercial: www.manningtoncommercial.com.
5. Tarkett Inc. www.commercial.tarkett.com.
6. Approved substitute.

D. Acceptable Manufacturers - Rubber Base and Vinyl Edging:
1. Johnsonite Rubber Company: www.commercial.tarkett.com.
2. Roppe Rubber Corporation: www.roppe.com.
3. Mannington Commercial: www.manningtoncommercial.com.
4. Flexco Company: www.flexcofloors.com.
5. Armstrong: www.armstrongflooring.com.
6. Approved substitute.

E. Acceptable Products - Rubber Base and Vinyl Edging:
1. 1/8-inch thick rubber base with top and toe cove. 4-inches high unless other sizes are indicated. Provide preformed external corners. Job-formed internal corners may be used at Contractor's option.
2. Furnish vinyl edging 1-inch wide, 1/8-inch thick roll goods, at all exposed edges of resilient flooring and/or carpeting.

F. Acceptable Manufacturers - Sheet Vinyl for General Use:
1. Armstrong: www.armstrongflooring.com.
2. Mannington Mills: www.mannington.com.
3. Approved substitute.

G. Acceptable Manufacturers - Sheet Vinyl for Kitchens:
1. Altro Floors: www.altrofloors.com.
2. Approved substitute.

H. Acceptable Products - Sheet Vinyl:
1. General Use: 0.085-inch thick, "Possibilities Commercial Corlon", "Tapestry'' or "Petit Points" patterns by Armstrong.
2. Kitchens: 0.10-inch thick, Altro "Designer 25" slip resistant sheet vinyl flooring with aluminum oxide grains, silicon carbide, and quartz crystals distributed within flooring thickness. 2-meter wide rolls.

I. Acceptable Manufacturers - Weight Room Flooring:
1. Mondo America, Inc. www.mondoworldwide.com.
2. Pawling Corp.: www.pawling.com.
3. Regupol America: www.regupol.us.
4. Tuflex Rubber Products: www.tuflex.com.
5. Approved substitute

J. Acceptable Manufacturers - Rubber Stair Treads and Risers:
1. Nora Rubber: www.nora.com.
2. R.C. Musson: www.mussonrubber.com.
3. Roppe: www.roppe.com.
4. Approved substitute.

K. Acceptable Product - Rubber Stair Treads and Risers:
1. Roppe "Diamond Design Stair Treads and Landings" or equal of other acceptable manufacturer.

09 65 66 – RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Sheet vinyl resilient athletic flooring.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Samples.

D. Restrictions/Critical Criteria:
   1. Concrete Curing: Do not install floor system until concrete floor slab has cured a minimum of thirty (30) days and moisture content of concrete slab is within acceptable range established by the flooring manufacturer.
   2. Installer shall be approved by the manufacturer and have an installation crew fully trained and qualified to install the type of flooring to be furnished.

E. Warranties:
   1. Manufacturer's Warranty: Extended warranty against defects in materials and performance of the wearing surface for a period of 10 years from date of Substantial Completion.
   2. Installer's Warranty: Furnish warranty against defects in materials and workmanship for a period of 1 year from date of Substantial Completion. Warranty shall include adherence of flooring to substrate, telegraphing of slab control joints through the surface of the flooring, butt joints remaining tight and adherence and "wear off" of game line paint.

F. Extra Materials:
   1. Flooring:
      a. All usable scraps over 2 sq. ft. in area and wider than 8-inches.
      b. 2% overrun of flooring material used. Overrun is defined as continuous, full-width rolled goods.

   2. Adhesive: Furnish Owner with one (1) extra gallon of each type of flooring adhesive used.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Taraflex Multi-Use 6.2 Sports Flooring" by Gerflor: www.gerflorusa.com.
   2. "Lonwood Performa" by Lonseal: www.lonseal.com.
   3. Approved substitute

B. Product Description:
   1. Foam-backed sheet vinyl flooring designed for fully adhered athletic flooring applications.
      a. Seaming Method: Heat welded.
      b. Adhesive Method: Full-spread adhesive coverage to completely adhere flooring.
      c. Traffic-Surface Texture: Wood visual shall have wood grain embossed texture for a genuine wood appearance.
         1) Wood pattern shall accurately simulate the true visual appearance of natural athletic wood strip flooring.

      d. Color and Pattern: As selected by Owner from manufacturer's standard colors and patterns.

   2. Adhesive: Water-resistant type recommended by flooring manufacturer for substrate and conditions indicated.
   3. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by athletic flooring manufacturer.
   4. Heat Welding Rod: As supplied by indoor resilient athletic flooring manufacturer. Color shall blend with resilient athletic flooring color.
   5. Game-Line and Marker Paint: Complete system including primer; compatible with flooring and recommended by flooring and paint manufacturers.

09 66 00 – EPOXY TERRAZZO

PART 1 - GENERAL

A. Summary - Section includes:
   1. Thin-set epoxy terrazzo floor system

B. Referenced Standards/Minimum Criteria:
   1. Installer Qualifications: A qualified installer (applicator) who is acceptable to epoxy terrazzo manufacturer to install manufacturer's products. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products, and has a minimum of three years experience in installation of this flooring system.
   2. Source Limitations: Obtain primary terrazzo materials through one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
   3. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of aggregate from one source with resources to provide materials of consistent quality in appearance and physical properties.
   4. NTMA Standard: Comply with "National Terrazzo and Mosaic Association" Guide Specification and written recommendations for terrazzo type indicated unless more stringent requirements are specified.

C. Submittals Required:
1. Product data.
2. Shop drawings.
3. Samples.
4. Installer certificates/qualification data.

D. Restrictions/Critical Criteria:
1. Physical Properties with Aggregates; For resin blended with marble and granite, ground, grouted, and cured per requirements in NTMA's "Guide Specification for Epoxy Terrazzo". Comply with the following:
   a. Flammability: Self-extinguishing, maximum extent of burning 0.25 inch per ASTM D636.

2. Mix: Comply with NTMA's "Guide Specification for Epoxy Terrazzo" and manufacturer's written instructions for component proportions and mixing.
3. Concrete: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with epoxy terrazzo.
   a. Shot-blast surfaces with an apparatus that abrades the concrete surface.
   b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
   c. Test concrete as required to assure moisture content of floor slab is within limits set by manufacturer.

4. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.
5. General: Installation
   a. Comply with NTMA's written recommendations for terrazzo and accessory installation.
   b. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Guide Specification for Epoxy Terrazzo."
   c. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
   d. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

6. Flexible Reinforcing Membrane:
   a. Prepare and prefill substrate cracks with membrane material.
   b. Install membrane to produce full substrate coverage in areas to receive terrazzo.
   c. Reinforce membrane with fiberglass scrim.
   d. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

7. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
8. Divider and accessory Strips: Install in adhesive setting bed without voids below strips.

9. Fine Grinding: Grind with 120 or finer grit stones until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum or 70 percent aggregate exposure.
10. Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.
11. Construction Tolerances: Limit variation in terrazzo surface from level to 1/4 inch in 10-feet.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. "Thin-set Epoxy Terrazzo System" by General Polymers: www.generalpolymers.com.
   2. "Floorazzo" by Mats, Inc. www.matsinc.com.
   3. Approved substitute.

B. Product Description:
   1. Base Thickness: 3/8-inch.

09 67 00 – FLUID APPLIED FLOORING

PART 1 - GENERAL

A. Summary - Section Includes:
   1. Fluid applied quartz flooring. May be used in middle school and high school shower rooms/toilets (verify with School District).

B. Referenced Standards/Minimum Criteria:
   1. Installer Qualifications: Installer shall be approved by the manufacturer and shall have a minimum of three (3) years experience in installation of the flooring system.

C. Submittals Required:
   1. Product data.
   2. Color options/samples.

D. Restrictions/Critical Criteria:
   1. Slip Resistance: Slip resistance of finished flooring system shall match Architect approved samples. Textures may vary from room to room.
   2. Test concrete as required to assure moisture content of floor slab does not exceed flooring manufacturer's requirements and examine floor for planarity (1/4-inch per 10"-0").

3. Grind high spots and fill low spots or fill with underlayment compound. Contractor shall be responsible for leveling slab. Make every effort to keep the concrete dry and free from exposure to moisture. Representatives of the flooring manufacturer shall ascertain the adequacy of dryness. The surface shall be free of oil, dust, grease, paint, or other foreign substances which will interfere with adhesion of flooring system. Allow concrete floor slab to cure for at least 60 days before flooring system is installed. No curing agents, sealers, or hardeners shall be used to aid in curing concrete.
4. Apply flooring system in accordance with manufacturer's instructions, employing trained, approved mechanics, using equipment specifically designed for this purpose. Apply flooring to an approximate thickness of 1/8-inch to 1/4-inch and extend base up walls 6-inches. Flooring shall be tightly compacted and free from surface holes and depressions.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Silikal: www.silikalamerica.com.
   2. Dur-a-Flex: www.dur-a-flex.com.
   3. Approved substitute

B. Acceptable Products:
   1. Fluid Applied Quartz Flooring: Clear 100% solids epoxy, multi-component system with colored quartz granules broadcast between applications of epoxy coatings.
   2. Provide fillet at cove. Provide aluminum edge strips at changes in flooring materials. Provide primer as recommended by flooring manufacturer.

09 68 00 – CARPETING

PART 1 - GENERAL

A. Summary - Section Includes:
   1. Carpet with backing (sheet goods and tile)
   2. Carpet accessories and adhesive
   3. Sealing concrete floor slabs

B. Referenced Standards/Minimum Criteria:
   1. Performance Requirements: Carpeting shall meet the minimum requirements of the following Flame Retardant Tests. Test results shall be provided for each type of carpeting provided.
      a. Flame Resistance (Pill Test): Passes (CPSC FF-1-70 -ASTM D2859).
      b. Smoke Density: Less than 450 (ASTM E662).
      c. Flooring Radiant Panel: Class 1 (ASTM E648) Flame Spread: Less than 75 (ASTM E84).
      d. Fuel Contributed: Less than 50 (ASTM E84).

2. Carpet installer must have a minimum of five (5) years experience on installation of similar size and complexity. The installation crew must be fully qualified to install the type of carpet to be furnished.

C. Submittals Required:
1. Seaming diagram.
2. Product data.
3. Color options/samples.

D. Restrictions/Critical Criteria:
1. Provide manufacturer's standard carpet material warranty. Installer shall warranty covering the installation for one (1) year and that installer will, upon demand, repair or replace any carpet that does not adhere properly and will correct any condition due to faulty installation during the warranty period.
2. Extra Materials:
   a. Carpet: Furnish Owner with all usable scrap plus 6% overrun of each color and type used. Usable scrap is defined as any scrap size over two (2) sq. ft. in area and wider than 8-inches.
   b. Adhesive: Furnish Owner with one (1) extra gallon of each type of carpet adhesive used.
3. Level uneven floor joints or other irregularities in substrate by filling with latex underlayment. Sand leveled areas to provide a completely level surface. Any required grinding or chipping of concrete shall be at the expense of the Contractor. Remove rough spots and foreign matter which may be evident through the carpet.
4. Concrete Floor Slabs: Apply sealer to concrete floor slabs only if tests show moisture in excess of manufacturer's acceptable standard and if application of sealer is approved by carpet manufacturer. Concrete sealing will be paid for by the School District on a time and materials basis by Change Order.
5. Verify if Owner's separate contractor will install the carpet in the gym/multi-purpose room.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
1. Tarkett Commercial: www.commercial.tarkett.com.
2. Approved substitutes: School District may consider Interface: www.interface.com, and/or Mannington: www.manningtoncommercial, as approved substitutions.

B. Acceptable Products:
1. Corridor Carpet: High Schools, Middle Schools, and Elementary Schools:
   a. Tarkett Modular Carpet: "Crayon" with Powerbond Mark 1-RS Backing (18" x 18").
2. Classroom/Office Carpet - High Schools, Middle Schools, and Elementary Schools:
   a. Same pattern as in corridors except material is in sheet goods.

3. Entry Mat - All Schools:
   a. Tarkett Modular Carpet Geo Tile or "Abrasive Action II" (18" x 18" tiles) with RS Backing.

4. Concrete Floor Sealer:
   a. L & M Construction Chemicals, "L & M Dress and Seal WB"
   b. Sonneborn "Kure-N-Seal W".
   c. Approved substitute.

09 72 16 – VINYL WALL COVERING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Vinyl wall coverings not permitted.

09 72 19 – TEXTILE WALL COVERINGS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Grille cloth panels at speaker enclosures in auditoriums.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Shop drawings.
   2. Color options/fabric samples.

D. Restrictions/Critical Criteria:
   1. Install panels with concealed fasteners.

PART 2 - PRODUCTS

A. Acceptable Materials:
   1. Mellotone Speaker Grille Cloth by Wendell Fabrics: www.wendellfabrics.com, with fabric mounting system by Snap-Tex Systems, Inc. www.snaptex.com.
   2. Approved substitute.

09 84 00 – ACOUSTICAL AND TACKABLE WALL PANELS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Acoustical wall panels.
   2. Tackable wall panels.

B. Referenced Standards/Minimum Criteria:
   1. Noise reduction coefficient per ASTM C423.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options/fabric samples.

D. Restrictions/Critical Criteria:
   1. The Architect may be required to incorporate acoustical panels in spaces such as music rooms, commons, gyms, auditoriums, swimming pools, etc. to improve the acoustical performance of these spaces. The Architect shall employ the services of an acoustical consultant to determine the specific requirements for acoustical treatment/panels.
   2. Tackable wall panels may be used (with School District approval) in corridors of elementary schools and in display cases of middle schools and high schools.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Decoustics: www.decoustics.com.
   2. Wall Technology, Inc. www.walltechnology.com.
   3. Conwed: www.conwed.com.
   4. Kinetics Noise Control: www.kineticsnoise.com.
   5. Eckel Industries, Inc. www.eckelusa.com.
   6. Approved substitute.

B. Acceptable Products - Acoustical Wall Panels (non-wet locations):
   1. Wall Technology A200 WP (typical) or A200 RE (impact areas), or equal of other acceptable manufacturer.
      a. Thickness and NRC rating: As required for acoustical performance.
      b. Flame Spread: Class A Flame Spread Rating of 25 or less per ASTM E84.
      c. Core: Medium high density perforated mineral fiberboard with hardened or aluminum square edges.
      d. Fabric: Manufacturer's standard woven fabric not less than 16.0 oz./lineal yard. Fabric shall be applied to face and edges of panel.

C. Acceptable Products - Acoustical Wall Panels (wet locations):

1. Eckel Eckoustic Functional Panels (EFP), or equal of other acceptable manufacturer.
   a. Thickness and NRC Rating: As required for acoustical performance.
   b. Flames Spread: Class A Flame Spread Rating of 25 or less per ASTM E84.
   c. Core: 1.5 pcf density fiberglass enclosed in 2 mil thickness "flame guard" polyethylene with aluminum framing members.
   d. Facing: V-ridged on 6-inch centers, 0.32-inch thick perforated aluminum. Polyurethane enamel factory finish, custom color as selected by Architect.
   e. Mounting: 11 gauge Type 316 stainless steel wall brackets with stainless steel fasteners.

D. Acceptable Products - Tackable Wall Panels:
   1. Thickness: 5/8-inch with tackable back under fabric.
   2. Flame Spread: Core - 20, finish - 15.
   3. Fabric: Manufacturer's standard woven fabric. Fabric shall be applied to face and edges of panels.

09 90 00 – PAINTING AND COATING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Paints.
   2. Stains/transparent finishes.
   3. High performance multi-color coating.

B. Referenced Standards/Minimum Criteria:
   1. Follow recommendations of "Architectural Specifications Manual" by the Painting and Decorating Contractors of America.

C. Submittals Required:
   1. Product data. Include brand and quality of each material.
   2. Color options/samples of paint and stain.
   3. Color verification samples.

D. Restrictions/Critical Criteria:
   1. Color Schedule: The Architect will provide a color schedule to the Contractor listing paint colors selected. If materials of other manufacturers are used, colors must match selected colors and samples will be required by the Architect. Paint color selections will refer to base coats only and may be subject to minor alterations prior to application of final coat; no final coat shall be applied until authorized by the Architect.
   2. Architect to verify with School District locations where walls are to receive multi-color textured coatings. Typically, this special coating is used on block and drywall in corridors of middle schools and high schools.
   3. At the completion of project, turn over manufacturer draw-downs for all paints used.
   4. The application of the first coat by Contractor does not relieve him of the responsibility for the base. Do not apply coats on damp or wet surfaces. Spread finish evenly and thoroughly brush out. Sand work between coats. Finish the upper and lower edges of

wood doors the same as the face. This work shall be done after doors have been fitted and are ready for final hanging.

5. Where paint is rolled on, use a fine nap roller so a nearly flat or orange peel texture is obtained.
6. Coating Systems - Interior: Minimum of the following: Primer may be omitted when refinishing existing surfaces.
   a. Woodwork, hollow metal doors/frames, ferrous, zinc coated or factory-primed metals:
      1) First coat: Suitable latex primer or factory-prime coat.
      2) Second coat: Waterborne acrylic urethane enamel, semi gloss.
      3) Third coat: Waterborne acrylic urethane enamel, semi-gloss.
   b. Plaster and Drywall - Painted:
      1) First coat: Suitable primer.
      2) Second coat: Interior acrylic latex, semi gloss; ceiling eggshell.
      3) Third coat: Interior acrylic latex, semi-gloss, ceiling eggshell.

   c. Block and Concrete - Painted:
      1) First coat: Heavy-duty acrylic latex block filler.
      2) Second coat: Interior acrylic latex, semi-gloss.
      3) Third coat: Interior acrylic latex, semi-gloss.

   d. Block – Epoxy:
      1) First coat: Latex block filler approved for use with epoxy paint.
      2) Second coat: Water borne epoxy, semi-gloss.
      3) Third coat: Water borne epoxy, semi-gloss.
      4) Apply block filler in Kitchen and Toilets with squeegee to ensure that all pores are covered before applying enamel. Surfaces must be as smooth as possible and be inspected and approved by Tri-County Health Department before proceeding.

   e. Concrete and Drywall - Epoxy:
      1) First coat: Suitable primer approved for use with epoxy paint.
      2) Second coat: Water borne epoxy, semi-gloss.
      3) Third coat: Water borne epoxy, semi-gloss.

   f. Drywall to Receive Multi-Color Texture Coating:
      1) First coat: Plextone MultiColor System Primer as recommended by manufacturer for substrate with contrasting color to finish.
      2) Second coat: Plextone Multicolor System "Plextone MultiColor", 6 mil dry film thickness
      3) Third coat: Plextone Multicolor System, 100% solids epoxy clear top coat

   g. Block to Receive Multi-Color Textured Coating:
      1) First coat: Seagrave Duramel-X Primer with contrasting color to finish.
      2) Second coat: Seagrave Plextone, 6 mil dry film thickness.
      3) Third coat: Seagrave Plexcoat top coat.

h. Woodwork - Stained (also for doors which are not factory finished):
   1) First coat: Wood stain - oil based.
   2) Second coat: Water borne polyurethane, gloss.
   3) Third coat: Water borne polyurethane, satin.

7. Coating Systems - Exterior:
   a. Ferrous Metals - Painted:
      1) First coat: Factory prime coat or suitable primer.
      2) Second coat: Water borne acrylic urethane enamel, semi-gloss.
      3) Third coat: Water borne acrylic urethane enamel, semi-gloss.

   b. Exposed Exterior Structural Steel, Metal Doors, Hollow Metal Door and Window Frames, and Metal Stairs - High Performance Coating (verify locations with School District). The School District may opt for substituting exterior alkyd semi-gloss enamel for Tnemec second and third coats:
      1) First coat: Factory prime coat - Tnemec Series 161 – 1255.
      2) Second coat: Tnemec Series 73, Endura Shield II (Spray Applied) 4.0-5.0 dry film thickness.

   c. Zinc Coated Metal (Galvanized) - Painted:
      1) First coat: Galvanized iron primer.
      2) Second coat: Latex semi-gloss enamel, exterior.
      3) Third coat: Latex semi-gloss enamel, exterior.

   d. Exterior Split Face Block
      1) First coat: Water borne Masonary Waterproofer

8. Special Areas:
   a. Gymnasium Ceilings: Spray or brush paint exposed deck, structural steel, joists, conduit, ducts, registers, mechanical units, piping, insulation, light fixture hangers, speaker housings, etc., as follows:
      1) First coat: Suitable latex primer or factory prime coats on metal Semi-gloss latex enamel.
      2) Second coat: Suitable latex primer or factory prime coats on metal Semi-gloss latex enamel.
      3) Third coat: Semi-gloss latex enamel coats as required for acceptable coverage.
      4) Deck and structural steel may be painted one color and ductwork a separate color. Other items will be painted to match adjacent deck, structural steel, or ductwork.

9. Miscellaneous Requirements/Criteria:
   a. Mechanical Piping and Ductwork: Wherever insulated pipe or ductwork occurs in rooms where walls or ceilings are finished, cover insulation jacket with one (1) coat of sealer and two (2) coats eggshell paint.
      1) Wherever uninsulated piping or ductwork occurs in rooms where walls or ceilings are finished, piping or ductwork shall be painted as called for under ferrous, zinc coated, or factory-primed metals.

2) Identification markings will be applied by contractor for mechanical work.

b. Grilles, Registers, Louvers: Grilles, registers, and louvers shall be painted, thoroughly covering surfaces that are visible after installation. After installation, touch up screws and scuffed spots or repaint as required to achieve a uniform paint job.
c. Boiler Stacks: Paint steel stacks with 400- to 700-degree F. heat resistant stack paint.
d. Objects on Roof: Paint metal objects on the roof including, but not limited to, flashings, vents, exhaust fans, air intake hoods, roof hatches, etc., as specified under ferrous, zinc coated metals. Prime aluminum with zinc chromate primer and paint as specified for ferrous or zinc coated metals. Paint rooftop units only if desired color cannot be obtained as a factory finish from rooftop supplier.
e. Prime Coated Hardware: Paint removable mullions and prime coated hardware as specified under ferrous, zinc coated, or factory-primed metals - painted.
f. Metal Glazing Frames (in wood doors): Paint as specified for ferrous, zinc coated, or factory-primed metals - painted.
g. Electrical Wiremold, Plugmold, and Exposed Conduit: Paint to match surface on which installed.
h. Coiling Doors, Rolling Counter Doors, and Grilles: Paint exposed primed components with factory finish as specified for factory-primed metals.
i. Pass-Doors in Folding Panel Partitions: Paint as specified for factory-primed metals - painted.
j. Shelving and Trim: Finish paint or stain shelving and trim, except those with factory finish. Hardware veneer shelving and trim shall be stained and finished; other wood shelving and trim shall be painted.

PART 2 - PRODUCTS

A. Acceptable Manufacturers: The best quality materials ("best grade" or "first line") as manufactured by any of the following manufacturers will be acceptable for use on the work:
1. For brush, roller or spray work:
a. Sherwin-Williams: www.sherwin-williams.com.
b. Benjamin Moore: www.benjaminmoore.com.
c. Approved substitute.

2. Epoxy Coating: Pittsburgh Paints or Sherwin-Williams; water borne.
3. Exterior High-Performance Coating: Tnemec, no substitutes.
4. Multi-color textured coating (base coat): Plextone MultiColor System "Plextone MultiColor" water borne pigmented modified terpolymer, no substitutes.
5. Top Coat for Multi-Color Textured Coating: Plextone MultiColor System, 100% solids epoxy clear coating as recommended by manufacturer, no substitutes.

END OF SECTION

DIVISION 10 - SPECIALTIES

10 11 00 – VISUAL DISPLAY BOARDS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Markerboards.
   2. Tackboards.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Shop drawings.
   2. Color options.

D. Restrictions/Critical Criteria:
   1. Manufacturer shall provide fifty (50) year warranty on finish of boards.
   2. Accessories: Each markerboard unit shall be equipped with a continuous top display rail and bottom tray. Provide a total of two (2) roller map brackets and four (4) combination map and paper holders per classroom, sized to fit on display rail.
   3. Provide music staff on boards in Music Rooms. Lines shall be factory painted and fused to board; taped lines are not acceptable.
   4. Finish: Exposed trim and accessories shall be extruded 6063-T5 aluminum alloy with clear anodized finish.
   5. Provide wood blocking within gypsum board partitions as necessary to secure boards to walls.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Chalkboard, Markerboards, Tackboards, Trim and Accessories:
   1. ADP/Lemco, Inc. www.adplemco.com.
   2. Claridge Products: www.claridgeproducts.com.
   3. Ghent Manufacturing, Inc. www.ghent.com.
   4. Marsh Industries: www.marsh-ind.com.
   5. Magnatag Visible Systems: www.magnatag.com.
   6. Nelson/Adams Co. www.nelsonadamsnaco.com.
   7. Polyvision: www.polyvision.com.
   8. Approved substitute.

B. Acceptable Markerboards: Porcelain Enamel steel. Face sheet metal shall be 28 gauge or heavier. Core material shall be particleboard with overall thickness not less than 7/16-inch. Back shall be 0.15-inch thick aluminum sheet. Pre-frame boards at the factory into trim system

specified. Size shall be 5'-0" high (Primary Schools) or 4'-0" (Secondary Schools) by required length. Boards up to 12-feet in length shall be in one piece.

C. Acceptable Tackboards: 1/4-inch thickness vinyl plastic cork factory laminated to 1/4-inch thickness hardboard backing. Pre-frame at the factory into trim system specified. Size shall be 4'-0" high by required length.

10 14 00 – IDENTIFYING DEVICES

PART 1 - GENERAL

A. Summary - Section includes:
   1. ADA Tactile Signs.
   2. Changeable Message Signs.
   3. Symbol Signs.
   4. Outdoor LED digital marquee.
   5. Dedication Plaque (by School District).
   6. Wall mounted building identification sign (by School District, layout by Architect).

B. Referenced Standards (Minimum Criteria):
   1. ADA signs for ADA requirements.

C. Submittals Required:
   1. Shop Drawings.
   2. Color Options / Samples.

D. Restrictions/ Critical Criteria:
   1. Architect to provide as part of the construction documents, a signage schedule for doors/rooms. Specific rooms names and numbering / naming of signs shall be approved by the school district.
   2. General Signage Description: Raised numbers, letters, pictograms, and Braille shall be precision injection molded on photopolymer metal base plate. Photopolymer plate shall be secured to minimum 1/8-inch thick plexiglass backplate. Changeable message signs shall have photopolymer plate mounted on clear Plexiglass coverplate over changeable message slots. Changeable message slots shall be formed by solid color spacers on backplate. Exposed surfaces of all sign types shall have solid color. Comers of sign types shall have 1/2-inch radius. Text and background shall be contrasting colors, matte finish. Photopolymer paint shall be Matthew's Paint (Acrylic Polyurethane - Satin Finish Paint). Install signs with tamper resistant adhesive.
      a. Room Signs:
         1) Size: Rooms signs with number and text shall be 7-inches high x 7-inches wide.
         2) Text Size: 1/32-inch raised, 1-inch high numbers and 5/8-inch letters, Helvetica Medium, upper and lower case, left center cop, all one line.
         3) Braille: Grade 2, raised 1/32-inch.

b. Symbol Signs:
   1) Size: 7-inches wide x 9-inches high.
   2) Symbol: 1/32-inch raised. 3-inches high minimum symbols as directed by Architect.
   3) Lettering: 1/32-inch raised, 1-inch high Helvetica Medium, upper and lower case.
   4) Braille: Grade 2, raised 1/32-inch.

c. Changeable Message Signs:
   1) Size: 7-inches wide x 7-inches high.
   2) Braille: Grade 2, raised 1/32-inch.
   3) Text Size: 1/32-inch raised, 1-inch high numbers and 5/8-inch high letters, Helvetica Medium, upper and lowercase.

d. Outdoor LED Digital Marquee:
   1) Outdoor LED Digital Marquee signage to help inform the community of school events, news and information to parents and students. Digital signs are used to promote school spirit, recognize outstanding teachers and award-winning students, and remind parents about school closures and academic and enrollment dates, all while engaging with high-visibility motion graphics.
   2) Size: Per project.
   3) Graphics to include School Name and Mascot Logo.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. ASI Sign Systems: www.asisignage.com.
   2. Best Sign Systems: www.bestsigns.com.
   3. Communication Industries, Inc. Golden, CO.
   4. Division Ten Signage Corp. www.division10sign.com.
   5. Platte Valley Signs. Aurora, CO.
   6. Signage, Inc.
   7. Signworks, LLC: www.wearesignworks.com.
   8. Approved Substitute.

10 21 13 – METAL TOILET COMPARTMENTS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Metal toilet compartments.

B. Referenced Standards/Minimum Criteria:
   1. ANSI A117.1 – Standard for Accessible and Usable Buildings and Facilities
   2. None.

C. Submittals Required:
   1. Shop drawing.
   2. Color options.

D. Restrictions/Critical Criteria:
   1. Construction:
      a. Doors and Partitions: 1-inch thick made of two sheets of 20 gauge galvanized-bonderized cold-rolled steel assembled over and cemented under pressure to a 7/8-inch thick sound- deadening fiber core. The two face plates on doors and partitions shall have formed edges and to be sealed together with continuous drawn oval crown locking strips; interlocking strips on doors and partition shall be mitered and welded at corners. Reinforce partitions for support of grab bars.
      b. Pilasters: 1-1/4-inch thick, constructed from two sheets of 20 gauge galvanized-bonderized cold-rolled steel assembled over and cemented under pressure to sound-deadening fiber core. Provide formed edges and continuous locking strips. Interlocking strips shall be mitered and welded at corners.
      c. Headrail: Headrail tubular anti-grip type, clear satin extruded aluminum attached and bolted through top of pilasters. Tubular bracing shall extend full length of installation and over end compartment and be fastened into wall bracket. Aluminum headrails other than anti-grip type shall not be used.

   2. Hardware and Fittings: Dividing partitions shall be attached to pilasters and wall with full-height steel or aluminum stirrup brackets. Base of pilasters and floor anchorage shall be concealed by 3-inch high, Type 304 stainless steel plinth. Doors shall be equipped with gravity hinges. Hinges adjustable for holding door in open position when not latched. Each door shall be equipped with one cast alloy chrome plated coat hook and bumper and cast alloy chrome- plated combination doorstop and latch keeper. Provide door pulls for out-swinging doors. Provide Glynn-Johnson bumpers which strike gypsum board walls. Urinal screens shall be supported with full-height steel or aluminum stirrup brackets at wall, and full-height pilaster from floor-to-ceiling or floor-to-headrail at front edge.
   3. Finish: Factory applied, baked-on acrylic enamel.

PART 2 - PRODUCTS

A. Acceptable Manufacturers and Type: Floor mounted, overhead braced, flush type, as manufactured by Sanymetal: www.sanymetal.com, or equal partitions by one of the following:
   1. Accurate Partitions Corporation: www.accuratepartitions.com.
   2. All American Metal Corporation: www.allamericanmetal.com.
   3. ASI Global Partitions: www.asi-globalpartitions.com.
   4. General Partitions Mfg. Corp.: www.generalpartitions.com.
   5. Hadrian, Inc. www.hadrian-inc.com.
   6. Knickerbocker Partition Corp.: www.knickerbockerpartition.com.
   7. Metpar Corporation: www.metpar.com.
   8. Scranton Products: www.scrantonproducts.com.
   9. Approved substitute.

10 21 16 – PLASTIC TOILET/SHOWER COMPARTMENTS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Plastic toilet shower/compartments (HDPE) in middle schools and high schools.

B. Referenced Standards/Minimum Criteria:
   1. ANSI A117.1 – Standard for Accessible and Usable Buildings and Facilities

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Construction:
      a. Partitions and Pilasters: 1-inch thick solid high-density polyethylene plastic.
      b. Headrail: Anti-grip type, clear satin extruded aluminum.

   2. Hardware and Fittings: Dividing partitions shall be attached to pilasters and wall with continuous aluminum or plastic wall brackets. Bottom of pilasters and floor anchorage shall be concealed by stainless steel or solid plastic shoe. Doors shall be equipped with gravity hinges. Provide anodized aluminum latch and strike.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Solid Plastic (Composite Constructed Panels are not acceptable):
   1. Santana: www.scrantonproducts.com.
   2. Global Partitions: www.globalpartitions.com.
   3. Sanymetal: www.sanymetal.com.
   4. Scranton Products: www.scrantonproducts.com.
   5. Approved substitute (School District may consider Bobrick "SierraSeries 1090" – Solid Color Reinforced Composite: www.bobrick.com/toiletpartitionsystems).

10 21 23 – CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

A. Summary - Section includes:
   1. Cubicle curtains and track in nurse's offices and health clinics.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Shop drawings.
   2. Color options.

D. Restrictions/Critical Criteria:
   1. Track to be designed for surface mounting on ceiling.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Alderman Acres Mfg. www.aldermanacres.com.
   2. A.R. Nelson Company, Inc. www.arnelson.com.
   3. Construction Specialties: www.c-sgroup.com.
   4. Imperial Fastener Co. www.imperialfastener.com.
   5. InPro Architectural Products: www.inpro.com.
   6. Approved substitute.

B. Acceptable Materials:
   1. Cubicle Track: General Cubicle Company (Construction Specialties) extruded aluminum track with nylon wheel carriers.
   2. Cubicle Curtains: One curtain per track required. Curtains to hang to within 15-inches of floor and shall be 10% wider than length of track. Cubicle curtain shall be manufactured utilizing Maharam Fabric Corporation 100% Trevira FR Polyester (inherently flame resistant). Style Duratex Game Board with 1/2-inch x 1/2-inch open Duratex Mesh sewn in the upper 18-inches of the cubicle curtain.

10 22 26 – FOLDING PANEL PARTITIONS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Paired-panel folding panel partitions.
   2. Single-panel folding panel partitions.
   3. Pass-doors through folding panel partitions.

B. Referenced Standards/Minimum Criteria:
   1. All partitions shall achieve specified STC ratings when tested by an approved independent acoustical laboratory in accordance with ASTM E90 and E413 test procedures.
   2. Upon completion, adjust partitions for smooth and easy operation and demonstrate use and maintenance to School District. Readjust in approximately 11 months after occupancy.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Provide manufacturer's standard pass-door system with partition panel. Pass door shall be equipped with hollow metal frame and door with friction latch and recessed pull. No threshold permitted. Prime paint door and frame for field painting (verify).

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Advanced Equipment Corp. www.advancedequipment.com.
   2. Hufcor: www.hufcorworldwide.com.
   3. Moderco: www.moderco.com.
   4. Modernfold: www.modernfold.com.
   5. Approved substitute.

B. Acceptable Models - Paired Panels:
   1. "Pathfinder 5500-R Series" by Hufcor.
   2. "Acousti-seal 932" by Modernfold.
   3. Approved substitute.

C. Acceptable Products – Paired Panels:
1. Type: Paired panels, top supported, manually operated. Provide fixed top seal and manually activated bottom mechanical seals and all factory hardware. Hinged panel closure in stacked position shall not protrude beyond stacked panels.
2. Panel Construction: Gypsum board skins assembled to welded steel frame. No exposed vertical edge trim allowed.
3. Suspension System: Center stack with Modernfold No. 17 track (steel or aluminum - standard of manufacturer) with four-wheel steel ball-bearing trolley; bracket or direct mount as indicated.
4. Markerboards: Provide liquid type white markerboards with recessed chalk trays (minimum one tray per marker board) where required by School District.
5. Panel Finish: Manufacturer's heavy weight (27 oz./lineal yard) vinyl wall covering.
6. STC Rating: Minimum of 43.
7. Accessories: If loose manual operating devices are required for bottom seals, furnish one (1) device for each side of partition.

D. Acceptable Models - Single Panels:
1. "Acousti-seal 931 Series" by Modernfold.
2. "Series 600" by Hufcor.
3. Approved substitute.

E. Acceptable Products:
1. Type: Individual panels, top supported, manually operated. Provide fixed top seal and manually activated bottom mechanical seals and all factory hardware.
2. Panel Construction: Steel face skins over assembled to welded steel frame. No exposed vertical edge trim allowed.
3. Suspension System: Off-set stack as indicated with Modernfold Omni-Directional track with programmed switches (steel or aluminum - standard of manufacturer) with four-wheel steel ball-bearing trolley; bracket or direct mount as indicated.
4. Markerboards: Provide liquid type white markerboards with recessed chalk trays (minimum one tray per marker board) where required by School District.
5. Panel Finish: Manufacturer's vertical ribbed carpet finish
6. STC Rating: Minimum of 49 at stage areas of elementary/middle schools and 43 at other locations.
7. Accessories: If loose manual operating devices are required for bottom seals, furnish one (1) device for each side of partition.

10 26 00 – WALL PROTECTION

PART 1 - GENERAL

A. Summary - Section includes:
   1. Solid color vinyl corner guards.
   2. Stainless steel corner guards.
   3. Wall guards.

B. Referenced Standards (Minimum Criteria):
   1. None.

C. Submittals Required:
   1. Product Data.
   2. Color Options.

D. Restrictions/ Critical Criteria:
   1. Use colored vinyl corner guards to match color of walls in all schools where gypsum board is used for corridor walls.
   2. Stainless steel corner guards shall be installed on outside corners in kitchen area.
   3. Sheet wall covering manufacturer of extruded rigid plastic or stainless steel sheet material may be used in lieu of ceramic tile in student restrooms. Verify with owner.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Vinyl Corner Guards:
   1. InPro Architectural Products: www.inprocorp.com.
   2. Pawling Corporation: www.pawling.com.
   3. Koroseal Interior Products: www.koroseal.com.
   4. Construction Specialties, Inc. www.c-sgroup.com.
   5. Balco: www.balcousa.com.
   6. Approved substitute.

B. Description:
   1. Material: Solid color PVC vinyl extrusion with embossed finish, 0.10-inch thickness minimum.
   2. Size: 2-1/2-inches x 2-1/2-inches by full height of wall (floor to ceiling).
   3. Configuration: 90-degree angle and other angles as required.
   4. Mounting: Adhesive.
   5. Fire Rating: Class I (ASTM E84).

C. Acceptable Manufacturers – Stainless Steel Corner Guards
   1. InPro Architectural Products: www.inprocorp.com.
   2. Pawling Corporation: www.pawling.com.
   3. Balco: www.balcousa.com.
   4. Approved substitute.

D. Description:
   1. Material: 16-gauge, Type 304 stainless steel with #4 satin finish.
   2. Size: 3-1/2-inches x 3-1/2-inches x 4'-0".
   3. Configuration: 90-degree angle and other angles as required.
   4. Mounting: Adhesive.

E. Sheet Wall Covering: Stainless Steel
   1. Material: 0.0625-inch, Type 304 stainless steel with #4 finish.
   2. Radius Corners: 1/8-inch.
   3. Exposed Edge Finish: Ease all exposed edges.
   4. Size: 4'-0" high x length of wall.
   5. Mount tight to wall with silicone adhesive.

10 28 00 – TOILET AND SHOWER ACCESSORIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Toilet and shower accessories.

B. Referenced Standards/Minimum Criteria:
   1. ANSI A117.1 – Standard for Accessible and Usable Buildings and Facilities.
   2. None.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Owner will furnish toilet tissue dispensers, soap dispensers, and paper towel dispensers to Contractor for installation. Remaining accessories shall be provided by Contractor.
   2. Fasten accessories rigidly and securely to walls using methods and materials recommended by manufacturer. Provide wood blocking or plywood in stud cavity for mounting accessories to gypsum board partitions.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. American Specialties, Inc. (ASI): www.americanspecialties.com.
   2. Bobrick Washroom Equipment, Inc. www.bobrick.com.
   3. Bradley Corporation: www.bradleycorp.com.
   4. Approved substitute.

B. Acceptable Products:
   1. Mirror: Bobrick "B-165 Series", sizes per design, or equal of other acceptable manufacturer.
   2. Hand Dryer (High School/Middle School): Bradley "Model 2902" or equal by other acceptable manufacturer. All dryers to have fixed nozzles.
   3. Grab Bars: Bobrick "B-68137", "B-6806" and "B-6861" or equal of other acceptable manufacturer.
   4. Sanitary Napkin Disposal (High School/Middle School): Bobrick "B-270" or equal of other acceptable manufacturer.
   5. Sanitary Napkin Vendor (High School/Middle School): Bradley "Model 4781-11" or equal of other acceptable manufacturer.
   6. Shower Rod/Curtain/Hooks (High School/Middle School): Bobrick "B-6047", "204-2", "204-1", or equal by other acceptable manufacturer.
   7. Robe/Towel Hook (High School/Middle School): Bobrick "B-672" or equal of other acceptable manufacturer.
   8. Mop Holder and Shelf: Bobrick "B-224 x Length" required.
   9. Splash Guard: Provide wall mounted 18-gauge stainless steel splash guards on walls above mop basins to 4-inches above height of faucet.
   10. Stainless Steel Mirrors: 20 gauge stainless steel mirrors with edges formed around 1/4-inch tempered hardboard. Adhere steel face to hardboard. Mirror shall be free of distortion and installed with vandal proof stainless steel screws.

10 44 00 – FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

A. Summary - Section Includes:
   1. Fire extinguisher cabinets.
   2. Fire extinguishers for fire extinguisher cabinets.
   3. Fire blanket cabinets in chemistry labs.

B. Referenced Standards/Minimum Criteria:
   1. Fire rated cabinets shall be one-hour rated and non-combustible, and meet the requirements of ASTM E814 "Standard Test Method for Fire Tests of Penetration Firestop Systems".

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Cabinets: Install cabinets to manufacturer's instructions. Install cabinet with door handle height of 4'-0" A.F.F. field paint cabinets. Apply decals on cabinets after cabinets are field painted.

PART 2 - PRODUCTS

A. Acceptable Manufacturers: Fire Extinguishers and Cabinets:
   1. J.L. Industries: www.activarcpg.com.
   2. Larsen's Manufacturing Company: www.larsensmfg.com.
   3. Elkhart Brass Manufacturing Company: www.elkhartbrass.com.
   4. General Fire Extinguisher Corporation: www.generalfireequipment.net.
   5. Potter-Roemer: www.potterroemer.com.
   6. Approved substitute.

B. Acceptable Products:
   1. Non-Rated Cabinets: Larsen's Manufacturing Co., "Model 2409 Architectural Series" steel or equal of other acceptable manufacturer with 24" x 9-1/2" x 5" minimum inside dimensions. Provide Duo Panel Break Glass Door. Cabinet finish shall be factory painted acrylic enamel as primer coat. Provide red decal reading "FIRE EXTINGUISHER" for job application. Cabinets shall be semi- recessed (ADA compliant) or fully recessed as required by wall conditions.
   2. Fire Rated Cabinets: Larsen's Manufacturing Co., "Model FS 2409" steel or equal of other acceptable manufacturer with 24" x 9-1/2" x 5" minimum inside dimensions.
   3. Fire Blanket Cabinets: Larsen's Manufacturing Co., "Model FB 3612-Series" steel or equal by other acceptable manufacturer with 36" x 12" x 8" minimum inside dimensions. Trim width to match other fire extinguisher cabinets. Cabinet finish shall be factory painted acrylic enamel as primer coat.
   4. Provide red decal reading "FIRE EXTINGUISHER" and "FIRE BLANKET" for job application.
   5. Cabinets shall be semi-recessed.
   6. Fire Blanket Cabinet shall be factory equipped with fire retardant blanket.

10 51 00 – LOCKERS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Student corridor lockers (middle schools and high schools).
   2. Athletic lockers (middle schools and high schools).
   3. Employee lockers (kitchen areas).
   4. Locker Room benches.

B. Referenced Standards (Minimum Criteria):
   1. ANSI A117.1 – Standard for Accessible and Usable Buildings and Facilities.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color Options.

D. Restrictions/Critical Criteria:

1. Student Corridor and Employee Lockers:

a. Material: Construct doors and frames of pickled, cold-rolled and patent leveled sheet steel. Construct other parts from good grade annealed specially treated and patent leveled steel.

b. Doors: Construct solid panel doors of 16 gauge cold-rolled sheet steel adequately flanged. Formations shall consist of two right angles at lock side of doors, two right angles at hinge side and one right angle formation at top and bottom. Weld all flanges together at corners.

c. Door Frames: Construct door frames of not less than 16 gauge steel formed into face channel shapes. Frame channel formation shall be securely welded together. Sides of frames shall form a continuous door strike.

d. Locking Device: Provide positive automatic type locking device of the pre-locking type whereby locker may be locked while door is open, then closed without unlocking and without damaging locking mechanism. There shall be three {3) latching points on single tier lockers and two (2) latching points on multi-tier lockers. Provide rubber silencers installed on each frame hook. Provide built-in combination locks and recessed handles on student corridor lockers. Employee lockers shall be padlockable.

e. Hinges: Five (5) knuckle hinges shall be at least two (2) inches high of the full loop, tight pinset type, securely welded to frame and riveted to door with two rivets per hinge. Locker doors 42-inches high and less shall have two hinges. Doors over 42-inches high shall have three hinges.

f. Body: Construct body of locker of not less than 24-gauge steel with necessary formation to make rigid locker and to ensure tight joints between bolts.

g. Tops, Bottoms, Shelves, and Tier Dividers: Constructed of 24-gauge sheet steel. Provide flat and sloping tops and necessary fillers for lockers as indicated or needed.

h. Fillers and Tops: Provide 24-gauge sheet steel blank front and top filler pieces of size required and necessary wherever groups of lockers adjoin in corners yet do not meet or wherever lockers abut walls.

i. Hooks: Provide hooks as noted. Hooks shall be zinc-plated forged steel with ball ends. Attach hooks with two bolts.

j. Number Plates: Provide each locker with polished aluminum plates, aluminum background and etched blank numerals not less than 3/8-inch high. Attach plates with split rivets. Number lockers per Owner's directions.

k. End and Back Panels: Where a group of lockers has an exposed end or back, provide prefinished 16-gauge end finishing panel securely attached to end or back of locker.

l. Finish: Thoroughly clean and phosphatize all steel parts. Finish with heavy coat of high-quality enamel. Enamel shall be baked at 300 degrees for minimum of 20 minutes. Where bolts heads are visible on outside of locker, finish to match balance of locker. Bolts and nuts shall be rust-proofed before finishing.

2. Athletic Lockers:
   a. General: Pre-assembled all welded construction. Sheet steel locker material shall be cold- rolled and patent leveled. Sheet steel shall be free from buckle, scale, and other imperfections. Steel angle framing members shall be continuous 1" x 1" x 1/8-inch pickled angle iron steel. Expanded metal shall be 13-gauge 3/4-inch flattened expanded metal with bond sheared edges to prevent snags or cuts.
   b. Sides and Vertical Partitions: Construct sides and partitions of expanded metal welded to angle frame.
   c. Shelves: Provide 16 gauge cold-rolled sheet steel shelf, flanged at sides, back and hemmed to front. Shelf to be welded to sides and back and shall be 12-inches from top of locker.
   d. Doors: Construct doors of expanded metal welded to angle frame. Provide solid cold- rolled 13-gauge sheet steel handle panel with 16 gauge back panel welded to frame at center span and latching device of door.
   e. Hinges: Doors over 42-inches high shall have three (3) hinges per door. Doors under 42-inches high shall have two (2) hinges per door. Hinges shall be heavy-duty five knuckle, full loop, tight pinset type. Hinges shall be minimum of 2-inches high. Hinges shall be welded to frame and riveted to door with two (2) rivets per hinge or welded to door, standard of manufacturer.
   f. Tops, Backs, and Tier Dividers: Constructed of solid 16-gauge sheet steel. Provide sloping tops and necessary fillers for lockers as indicated or needed. Backs may be 18-gauge sheet steel.
   g. Bottoms: Provide ventilated 16-gauge sheet bottom panels.
   h. Latching: Provide three (3) point positive latching mechanism with provision for padlock at single tier units. Provide lever-type handle to activate latching rods.
   i. Number Plates: Each locker shall have a polished aluminum number plate with black numerals not less than 3/8-inch high. Attach plates with rivets. Number lockers per Owner's directions.
   j. Hooks: Provide hooks as noted. Hooks shall be zinc-plated forged steel will ball ends.
   k. Fillers and Tops: Provide 16-gauge sheet steel blank front and top filler pieces of size required and necessary wherever groups of lockers adjoin in corners yet do not meet.
   l. End and Back Panels: When a group of lockers has an exposed end or back, provide solid 16-gauge end finishing panel attached to end or back of locker.
   m. Finish: Thoroughly clean and phosphatize all steel parts. Finish with a heavy coat of high-quality enamel. Enamel shall be baked at 300 degrees for a minimum of 20 minutes. Pool area lockers shall receive corrosion-resistant electro-galvanizing and high solids epoxy prior to color finish enamel.

3. Install locker numbers on each locker according to a schedule to be furnished by the Owner.
4. Locker Room Benches: Bolt to concrete floors in accordance with manufacturer's instructions.
5. Extra Materials: Provide the Owner at the completion of the project the following items:
   a. Locker Doors: Verify number of extra doors for each locker type with School District.
   b. Locking Devices: Twenty (20) Built-In Combination Locks
   c. Touch-Up Paint: Provide eight (8) fluid ounces for each 100 lockers or fraction, of each color installed; up to one (1) quart total for standard colors and up to two (2) quarts for custom colors.

PART 2 - PRODUCTS

A. Acceptable Manufacturers – Student Corridors and Employee "Quiet'' Lockers:
   1. Republic Storage Products, LLC: www.republicstorage.com.
   2. Lyon, LLC: www.lyonworkspace.com.
   3. Penco Products, Inc. www.pencoproducts.com.

B. Acceptable Manufacturers – Athletic Lockers:
   1. DeBourgh Mfg Co: www.debourgh.com.
   2. Lyon, LLC: www.lyonworkspace.com (alternate)
   3. Republic Storage Products, LLC: www.republicstorage.com (alternate)
   4. Penco Products, Inc. www.pencoproducts.com (alternate)

C. Locker Types and Sizes:
   1. Student Corridor Lockers – High Schools: Republic "Quiet Lockers" or equal by other acceptable manufacturer. Single tier "quiet'' type, 9-inches wide, 15-inches deep, 72-inches high, mounted on concrete or masonry base. Provide one double prong back hook, two single prong wall hooks, and one shelf. Recessed handle. Built-in combination lock.
   2. Student Corridor Lockers – Middle Schools: Republic "Quiet Lockers" or equal by other acceptable manufacturer. Double tier "quiet'' type, 9-inches or 12-inches wide, 15-inches deep, 36-inches high. Mounted on concrete or masonry base. Provide one double prong back hook, two single prong hooks, and on shelf. Recessed handle. Built-in combination lock.
   3. Athletic Lockers – High Schools: DeBourgh "All-Welded All-American Lockers" or equal by other acceptable manufacturer. Single tier "athletic type", 12-inches or 18-inches wide, 15-inches deep, 72-inches high, mounted on concrete or masonry base. Provide one double prong back hook, two single prong wall hooks, and one shelf. Sloping top. Lever-type handle. Padlocks by Owner.
   4. Athletic Lockers – Middle Schools: DeBourgh "All-Welded All-American Lockers" or equal by other acceptable manufacturer. Double and triple tier "athletic type", 18-inches wide, 15-inches deep, 60-inches high (each locker 20-inches or 30-inches), mounted on concrete or masonry base. Provide one double prong back hook, two single prong wall hooks. Sloping top. Lever-type handle. Padlocks by Owner.
   5. Kitchen Employees Lockers: Republic "Quiet Lockers" or equal of other acceptable manufacturer. Double tier "quiet'' type, 12-inches wide, 15-inches deep, 72-inches high, mounted on concrete or masonry base. Provide one double prong back hook, two single prong wall hooks. Sloping top. Lever- type handle. Padlocks by Owner.
   6. Security Office Employee Lockers at High Schools: Republic "Quiet Lockers" or equal by other acceptable manufacturer. Double tier "quiet'' type, 12-inches wide, 15-inches deep, 72-inches high, mounted on concrete or masonry base. Provide one double prong back hook, two single prong wall hooks and one shelf. Recessed handle. Padlocks by Owner.

D. ADA Compliant Lockers:
   1. Provide at least 5% of the lockers, but no less than one locker, to meet ADA requirements. For single tier lockers, the shelf and coat hooks must be lowered to no more than 48-inches above the floor, with an extra shelf added to bring the bottom of the locker to no lower than 15-inches above the floor. Provide Accessibility Graphic on locker face.

E. Locker Room Benches:
   1. Where benches are provided in Locker Rooms, provide benches in compliance with ADA requirements for size and clearances. Benches must have seats that are a minimum of 20-inches to a maximum of 24-inches in depth and 42-inches minimum in length.
   2. Provide benches with backs where accessible benches are not positioned against a wall.
   3. Benches must have a clear floor space positioned to allow persons using wheelchairs or other mobility devices to approach parallel to the short end of a bench seat.
   4. Benches must be strong enough to withstand a vertical or horizontal force of 250 pounds applied at any point on the seat, fastener, mounting device or supporting structure.

10 75 00 – FLAGPOLES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Flag Poles.

B. Referenced Standards (Minimum Criteria):
   1. None.

C. Submittals Required:
   1. Product Data.

D. Restrictions/ Critical Criteria:
   1. Description: Flagpole shall be 30-feet (exposed length) seamless cone tapered aluminum 6063- T6 tubing.
   2. Overall pole length shall be 3'-6" longer than exposed length. Flagpole wall thickness shall be minimum 0.188-inch with a minimum 6-inch butt diameter.
   3. Pole shall have standard revolving truck with one aluminum sheave, one polypropylene halyard, and two sets chrome plated snap hooks for two flags. Provide matching flashing collar.
   4. Flagpole shall have interior halyard system with manually operated cam action cleat, key operated flush access door with top revolving trunk and 6-inch ball.
   5. Provide galvanized corrugated steel foundation tube with self-centering bottom plate and lightning protector ground spike.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. American Flagpole & Flag Co.: www.aflag.com.
   2. Concord American Flagpole: www.concordamericanflagpole.com.
   3. Eder Flag Mfg. Co. www.ederflag.com.
   4. Pole-Tech Co., Inc. www.poletech.com.
   5. Approved substitute

END OF SECTION

DIVISION 11 - EQUIPMENT

11 06 20 – THEATRICAL CURTAIN AND TRACK

PART 1 - GENERAL

A. Summary - Section includes:
   1. Fabrication and installation of theatrical curtains indicated on the drawings, including tracks, all hardware and accessories.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Curtain fabric must meet flame spread requirements.

PART 2 - PRODUCTS

A. Acceptable Fabricators:
   1. Automatic Devices Corp. www.adctracks.com.
   2. Dincler Stage Equipment Division, Pueblo, CO.
   3. Theatrix, Inc., Denver, CO.
   4. Stagecraft Industries, Inc. www.stagecraftindustries.com.
   5. Barbizon: www.barbizon.com.
   6. Norcostco, Inc. www.norcostco.com.
   7. Approved substitute.

B. Curtain Track and Related Hardware:
   1. Main Drape: Automatic Devices Corporation "170 Track", complete with all necessary accessories. Provide manual rope and pulley assembly at one end with all required hardware. Eliminate track hangers and provide surface mounting, supported as required.
   2. Cyclorama Curtain: Automatic Devices Corporation "173 Track", complete with all necessary accessories for walk-along curtain. Curtain must have 360-degree track for performances either north or south side of stage. Provide all required hangers for support.
   3. Side Curtains: Provide two (2) Automatic Devices Corporation "172 Track", complete with all necessary accessories for walk-along curtain. Provide any necessary hangers for support.

4. Upper Valance Curtains: Suspend three, 4-feet high by (width required) curtains on pipe battens from structure above.
5. Hang from carriers with No. 43 S hooks at each grommet. Dead tie the off-stage end of the curtain within 2-inches of the track end pulleys.

C. Curtain Fabric:
1. Main Drape: KM Fabrics, Marvel, 21 oz. cotton velour, or approved substitute, color as selected by Architect from minimum of 20 colors. Curtain width and height per design.
2. Rear, Valance, and Side Leg Curtains: Atlas, 100% cotton, black, or approved substitute.

11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

A. Summary - Section includes:
1. Contractor installation of Owner furnished equipment.
2. Vent hoods over ranges furnished and installed by Contractor.

B. Referenced Standards/Minimum Criteria:
1. ANSI A117.1 - Standard for Accessible and Usable Buildings and Facilities
2. None

C. Submittals Required:
1. Coordinate installation and opening dimensions with the appliances to be installed within or adjacent to built-in casework and wall construction. Coordinate plumbing, mechanical, and electrical hook-ups to appliances.
2. Product data for vent hood.

D. Restrictions/Critical Criteria:
1. Contractor to obtain confirmation from School District of appliances and model numbers prior to casework shop drawings submittals. Owner will furnish cut sheets of actual appliances to be furnished.
2. Contract shall receive, uncrate, place in proper location, assemble, and connect appliances according to manufacturer's instructions. Connections to mechanical and electrical services by mechanical and electrical contractors.

PART 2 - PRODUCTS

A. Acceptable Manufacturers: NA

11 40 00 – FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Food storage equipment.
   2. Food preparation equipment.
   3. Food delivery carts.
   4. Food cooking equipment.
   5. Hood and ventilating equipment including fire suppression.
   6. Food dispensing equipment.
   7. Ice machines.
   8. Cleaning and disposal equipment.

B. Referenced Standards/Minimum Criteria: Work and materials must be in full accord and when applicable, must be listed as acceptable with the following agencies:
   1. U.S. Public Health Service.
   2. Local Health Department.
   3. National Board of Fire Underwriters.
   4. O.S.H.A.
   5. National Sanitation Foundation (N.S.F.).
   6. Underwriter Laboratories (U.L.).
   7. A.S.M.E.
   8. A.G.A.
   9. N.F.P.A. - 96 for exhaust system.
   10. A.S.T.M.
   11. Fabrication methods shall conform to all generally accepted conventions and requirements of the food service industry and shall meet or exceed the latest National Sanitation Foundation standards including all revisions.

C. Submittals Required:
   1. Shop drawings/rough-in drawings.
   2. Product data/cut sheet book - specification/data for each piece of equipment.

D. Restrictions/Critical Criteria:
   1. Architect shall employ a food service consultant who shall work with representative of the School District to design food service facilities and determine appropriate equipment to either be fabricated or purchased through the Contractor.
   2. Food service consultant shall attempt to reduce energy costs, where possible, by specifying gas fired equipment as opposed to electric equipment.
   3. Architect shall review shop drawings for fabricated and freestanding equipment with School District prior to release for fabrication.

PART 2 - PRODUCTS

A. Acceptable Manufacturers and Equipment:
   1. To be determined.

11 51 16 – BOOK DEPOSITORY

PART 1 - GENERAL

A. Summary - Section includes:
   1. Book drop-in media center of high schools.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Verify that wall to receive book drop is not required to be fire rated or if fire rating is required provide rated enclosure with access door behind book drop.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Book Drop: Fully assembled book depository with clear satin anodized aluminum front frame and hopper door with pull handle. Housing shall be constructed of primed steel welded at seams. Provide standard stainless steel chute and "slow down". Add keylock for controlled access. Provide three (3) keys. Frame shall be marked "Book Depository'' in engraved black filled letters.

11 52 13 – PROJECTION SCREENS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Projection screens.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.

D. Restrictions/Critical Criteria:
   1. Install screens according to manufacturer's instructions. Electrical Contractor to connect screens to power source and install switch/relay equipment.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Da-Lite Screen Company, Inc. www.da-lite.com.
   2. Draper Shade and Screen Co., Inc. www.draperinc.com.
   3. Stewart Filmscreen Corporation: www.stewartfilmscreen.com.
   4. Approved substitute

B. Acceptable Manufacturer and Type (for High School stage and/or Commons): Da-Lite "Senior Electrol" automatic projection screen or equal product of other acceptable manufacturer. Provide key operated recessed three position control switch in box with cover plate. Screens shall be flame retardant, mildew resistant, glass beaded with black border. Aspect Ratio: 16:10. Sizes (width): 9-feet or 18-feet (per design) with 3'-6" black extension.

C. Acceptable Manufacturer and Type (for Elementary Schools): Da-Lite "Cosmopolitan" or equal of other acceptable manufacturer. Provide key operated recessed three position control switch. Screen shall be flame retardant, mildew resistant, glass beaded with black border. Picture surface shall be directed towards gym. Aspect Ratio: 16:10. Sizes (width): 9-feet

11 53 00 – LABORATORY EQUIPMENT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Flammable storage cabinet.
   2. Vented acid storage cabinet.
   3. Goggle sanitizer cases.

B. Referenced Standards/Minimum Criteria:
   1. Regulatory Requirements: Cabinets must be in compliance with OSHA, NFPA, and IFC requirements for storage of flammable liquids.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.

D. Restrictions/Critical Criteria:
   1. Laboratory equipment must interface closely with casework or other equipment which may be installed. Contractor shall coordinate and schedule work to assure that casework and laboratory equipment are installed in an expeditious manner, fit properly together, and tightly fits in the space provided.

2. Deliver, uncrate, place in proper location, and assemble equipment covered by this Section. Set equipment accurately in place, level, scribe and secure. Provide connecting and attaching devices, closures and trim members as required. Install items complete and adjust moving parts to operate smoothly.

PART 2 - PRODUCTS

A. Flammable Storage Cabinets:
   1. Acceptable Manufacturers:
      a. Flinn Scientific: www.flinnsci.com.
      b. Lab Safety Supply Co. Distributed through Grainger: www.grainger.com.
      c. JustRite: www.justrite.com.
      d. Protectoseal: www.protectoseal.com.
      e. Terra Universal: www.terrauniversal.com.
      f. Approved substitute

   2. Acceptable Model: Single door, self-closing or approved substitute of other acceptable manufacturer.

B. Vented Acid Storage Cabinet:
   1. Acceptable Manufacturers:
      a. Flinn Scientific: www.flinnsci.com.
      b. Lab Safety Supply Co., distributed through Grainger: www.grainger.com.
      c. JustRite: www.justrite.com.
      d. Protectoseal: www.protectoseal.com.
      e. Terra Universal: www.terrauniversal.com.
      f. Approved substitute

   2. Acceptable Model: Lab Safety Model 9A-2151-2, including self-closing door feature or approved substitute of other acceptable manufacturer

C. Goggle Sanitizer Cases with UV Lamp:
   1. Acceptable Manufacturer:
      a. Ker-Kau Manufacturing Company: www.kerkau.com.

11 53 13 – FUME HOODS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Bench-top laboratory fume hoods in science area.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Deliver, uncrate, place in proper location, and assemble fume hoods, bases, and equipment covered under this Section. Set fume hoods accurately in place, level, scribe and secure to base. Provide connecting and attaching devices, mechanical/electrical connections, closures and trim members as required. Install items complete and adjust moving parts to operate smoothly.
   2. Provide fume hoods of baffle design to provide a 100 fpm exhaust air volume through the hood when sash is in full open position. Do not provide exhaust fan in fume hood (exhaust performed by roof mounted exhaust fan).
   3. Provide wood panels with acid resistant coating in a streamlined section ensuring a consistent flow of air into the hood. Design the hood interior and end panels flush with the entrance shape to prevent eddy currents and backflow of air.
   4. Pre-pipe and pre-wire all hoods to a single location on the back of the unit.
   5. Vertical Sliding Sash: Provide 0.125-inch clear polycarbonate.
   6. Hood Working Surface: Provide a 1.25-inch thick chemical resistant plastic laminate work surface.
   7. Fabricate base cabinets from wood matching hood exterior with swinging doors and one adjustable shelf. Provide manufacturer's standard cabinet lock. Furnish two keys.
   8. Include factory finished sides, base and filler panels.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Fume Hoods:
   1. Fisher Scientific, Inc. www.fischersci.com.
   2. Hamilton Laboratory Solutions: www.hamiltonlab.com.
   3. Kewaunee Scientific Equipment Corp. www.kewaunee.com.
   4. Labconco: www.labconco.com.
   5. Air Master Systems Corp. www.airmastersystems.com.
   6. Approved substitute.

B. Fume Hood Types:
   1. Fume Hood Type 1: Thermo Scientific Hamilton, "SafeAire II Constant Volume Bypass Fume Hood". Size: 48 inch.
   2. Fume Hood Type 2: Labconco, "Protector ClassMate HOPEC IV Laboratory Hood". Size: 48 inch.

C. Fume hoods shall be complete with epoxy resin work surface, blower switch, gas, water, electric receptacles, cup sink, and vapor-proof fluorescent light fixture with external light switch.

11 57 00 – CERAMIC KILNS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Coordination, set up, hook up, and final connections to Owner furnished:
      a. Electric kiln and optional accessories.
      b. Gas kiln and optional accessories (high school).

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. None.

D. Restrictions/Critical Criteria:
   1. Owner will furnish catalog cuts and product data for manufactured items specified under this Section. Product data will include equipment rough-in requirements indicating exact locations of electrical and mechanical rough-in penetrations through the floor or walls. Review electrical and mechanical rough-in show on drawings.
   2. Receive, deliver, uncrate, place in proper location, and assemble all equipment covered by this Section. Set equipment accurately in place, level and secure as directed. Provide connecting and attaching devices as required. Install items complete and adjust moving parts to operate smoothly.

PART 2 - PRODUCTS FURNISHED BY SCHOOL DISTRICT

A. Ceramic Kiln - Electric:
   1. Manufacturer and Type: "Model KMT-1018" as manufactured by Skutt Kilns: www.skutt.com.
   2. Operation System: Electric (architect to verify voltage requirements)
   3. Firing Capacity: 4.6 cu. ft.
   4. Accessories:
      a. Limit timer.
      b. 4-1/2-inch blank ring.

c. 6 half shelves.
d. Stak-up post assortment.
e. Environment exhaust system.

B. Ceramic Kiln – Gas:
1. Manufacturer and Type: "Model CW-16F" as manufactured by Cooperworks Company
2. Operation System: Two (2) each high efficiency forced air burners. 170,000 BTU/burner.
3. Firing Capacity: 4.6 cu. ft.
4. Accessories:
a. Electronic ignition.
b. Collection hood.

11 61 23 – ORCHESTRA PIT COVER

PART 1 - GENERAL

A. Summary - Section includes:
1. Removable orchestra pit cover at High Schools.

B. Referenced Standards/Minimum Criteria:
1. All work, materials, equipment, and installation shall conform to applicable local and national trade codes and standards.
2. Manufacture and installation of the orchestra pit cover and storage truck shall be such quality as guided by professional staging practices. Lack of such quality shall be grounds for rejection.
3. Welding processes and operators for fabrication of structural steel components shall be qualified in accordance with AWS Standard Qualification Procedure. Installer shall certify that welders to be employed for this fabrication have satisfactorily passed AWS qualification tests within the previous twelve (12) months.

C. Submittals Required:
1. Shop drawings.
2. Product data.
3. Submit independent, third-party, test data from registered professional engineer licensed in the State of Colorado indicating conformance with the live and static loading performance requirements.

D. Restrictions/Critical Criteria:
1. Performance Specification
a. The pit cover shall be capable of supporting, without failure, a uniform load of 125 pounds per square foot. The pit cover shall consist of lift-out sections.
b. Storage trucks for pit cover sections shall be provided. Overall width of storage trucks shall not exceed 32 inches to allow easy passage through a 3'-0" doorway. Each truck shall have four (4) ball bearing hub casters with minimum 5-inch diameter, hard rubber wheels with load rating of 500 lbs. Each. Two (2) casters shall be fixed and two (2) casters shall be of the swivel type.

PART 2 - PRODUCTS

A. Acceptable Manufacturers of Pit Cover/Storage Trucks:
   1. SECOA Inc. www.secoa.com.
   2. Wenger Corporation: www.wengercorp.com.
   3. Norcostco: www.norcostco.com.
   4. Approved substitute.

11 63 23 – BACKSTOPS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Main court backstops.
   2. Practice court backstops.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Support System: Backstop supplier shall provide all required steel support structure and anchoring devices necessary to securely attach each backstop to steel roof members

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Backstops:
   1. Porter Athletic: www.gillporter.com.
   2. Aalco Manufacturing Company: www.aalcomfg.com.
   3. Draper, Inc. www.draperinc.com.
   4. Approved substitute.

B. Acceptable Backstops (high schools and middle schools):
   1. Forward Fold - Rear Braced Main Court Backstops in main gym and auxiliary gym: Porter Model No. 90950-000 "Center Strut'', ceiling suspended, or equal of other acceptable manufacturer. Provide Porter Model No. 00224-300 rectangular glass bank with Porter Model No. 00224-900 Pro-Strut adapter; No. 00227-000 bottom padding; and No. 00245-500 Power-Flex goal with net.
   2. Forward Fold - Rear Braced Practice Court Backstops: Porter No. 90950-W00 "Center Strut'', ceiling suspended, or equal of other acceptable manufacturer. Provide Porter Model No. 00228-300 rectangular Duralam bank; No. 00229-000 bottom padding; and No. 00245-500 Power-Flex goal with net.

C. Acceptable Backstops (elementary schools):
   1. Folding Backstop: Porter Model No. 90617-000 Motorized Forward Fold or equal of other acceptable manufacturer; adjustable height goal, Model No. 00228-300 rectangular wood bank, No. 229-000 bottom padding and No. 00225-000 goal with net.
   2. Fixed Backstop: Porter Model No. 90918-000 or equal of other acceptable manufacturer; stationary ceiling suspended rear braced with goal height adjustable from 8-feet to 10-feet; Model No. 00228-300 rectangular wood bank, No. 00229-000 bottom padding, No. 00225-000 goal with net.
   3. Practice Backstops: Porter Model No. 312 Standard Stationary Wall Mount or equal of other acceptable manufacturer. Rectangular wood bank No. 00228-300 and No. 00225-000 goal with net. Flush mount to wall.

D. Accessories - All Schools:
   1. Accessories: The following shall be provided for each backstop.
      a. Provide and install remote electric winches incorporating emergency provisions for manual operation in case of power failure. Winch design shall incorporate integral up and down limit switches. Safety disconnects shall be provided by backstop manufacturer. Winch motors shall be sized as required, 115V, single phase.

   2. Provide Porter Model No. 10798-000 "Safety Strap and Hoist Cable Retractor" to prevent accidental dropping of backstop in case of winch failure and to retract the hoist cable from area of play.
   3. Provide recessed type, three-position key selection switches with covers. Key switches shall have "spring return" to center off-position.

11 63 53 – GYM DIVIDER

PART 1 - GENERAL

A. Summary - Section includes:
   1. Roll-fold divider curtain in main gymnasium (high schools and middle schools).

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Support System: Gym divider supplier shall provide all required and necessary support system for divider to be secured to roof structure.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Gym Divider Curtain:
   1. Porter Athletic: www.gillporter.com.
   2. NGE, Inc. www.nge-inc.com.
   3. Aalco: www.aalcomfg.com.
   4. Approve substitute.

B. Manufacturer and Type: Porter No. 90675-100 "Roll-Fold Divider Curtain" or equal of other acceptable manufacturer. Entire curtain fabric to be anti-bacterial treated, fungi-resistant, and flame retardant. Curtain shall have wire polyester open mesh with PVC coating upper section and solid 8'-0" high vinyl polyester reinforced fabric lower section. Provide continuous bottom batten.

C. Provide and install remote, single phase electric winch and integral limit switches to automatically control upper and lower limits of travel. Safety disconnect shall be provided by gym divider installer. Winch motor shall be sized as required. Provide recessed three position key switch and cover plate. Key switch shall have "spring return" to center

11 66 00 – MAT MOVERS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Motorized wrestling mat mover and storage system at gymnasium.
   2. Necessary framing and support system to attach to roof and wall structure.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Verification of Conditions: Prior to beginning the installation of hoist equipment, Contractor shall examine the following to verify that no irregularities exist that would affect the quality of execution or work as specified:
      a. Location and soundness of structural members.
      b. Completion of work of other trades adjacent to hoist installation.
   2. Acceptance: Beginning of installation by Contractor means acceptance of existing conditions.
   3. Running Test: In the presence of the Architect, make a running speed test with full maximum load on the hoist equipment to determine whether the equipment as installed meets the speed, capacity and other requirements of the Specifications.
   4. Manufacturer shall provide two (2) year written warranty for material and installation.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Mat Mover System:
   1. Aalco Mfg. www.aalcomfg.com.
   2. NGE Inc. www.nge-inc.com.
   3. Porter Athletic: www.gillporter.com.
   4. Approved substitute

B. Mat Movers: Porter #91101-200 (high school) or #91101-100 (middle school) overhead supported mat mover or equal. Mat mover system shall consist of fully welded steel carriage structure with rails and fully assembled drive and lifting mechanism, standard of manufacturer. System shall include suspension trolleys, travel beam, load bar with sling, control panel, electric motors for hoist and tractor, drive tractor, key switches with covers, cables and pulleys, and other standard components of manufacturer required for fully operational system.
   1. Controls: Two (2) key switches at control station, located as directed by the Architect.
   2. Load Bar and Sling: Designed to support two (2) 42' x 42' mat for high schools, and (1) 42' x 42' mat for middle schools.
   3. Support Framing, and Anchoring System: As designed and provided by mat mover manufacturer.

11 66 43 – SCOREBOARDS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Scoreboards in gymnasiums (high schools and middle schools).
   2. Scoreboard in swimming pools.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Architect to verify with School District type and number of scoreboards.

PART 2 - PRODUCTS

A. Acceptable Manufacturers – Gymnasium Scoreboards:
   1. Fair-Play Scoreboards: www.fair-play.com.
   2. Daktronics: www.daktronics.com.
   3. Nevco Scoreboard Co. www.nevco.com.
   4. Approved substitute.

B. Acceptable Manufacturers – Swimming Pool Scoreboards:
   1. Colorado Time Systems: www.coloradotime.com.
   2. Daktronics: www.daktronics.com.
   3. Fair-Play: www.fair-play.com.
   4. Nevco Scoreboard Co. www.nevco.com.
   5. Approved substitute.

C. Scoreboards:
   1. Gymnasium Scoreboards: Fair-Play "Model BB-1620 Basketball/Wrestling/Volleyball Scoreboard" or equal of other acceptable manufacturer
   2. Swimming Pool Scoreboards: Colorado Time Systems "Model #4009S8-MS".

D. Control Console: Provide one (1) control console in Main Gymnasium capable of controlling both scoreboard panels in Main Gym from console on Scorer's table. Provide one duplicate control console with cord and carrying case to operate second scoreboard in Main Gymnasium (verify second scoreboard in middle schools) or both scoreboards in Auxiliary Gymnasium. Provide sufficient control cable to reach from scorer's tables in Main and Auxiliary Gymnasium bleachers to junction boxes on walls. Provide (1) control console in timer room to control scoreboard in pool areas. Verify if controls can be wireless.

E. Control Cable: Provide control cable of sufficient length to reach from boxes on walls behind scorer's table in both Gymnasiums.

F. Provide 2 rear illuminated top mounted personalization signs for scoreboards in main gym.

11 66 63 – GYMNASIUM EQUIPMENT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Floor sleeves.
   2. Wall padding.
   3. Climbing ropes and pipe beams.
   4. Climbing rope hoists.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings for equipment layout.
   3. Color options for wall padding.

D. Restrictions/Critical Criteria:
   1. Securely attach wall padding and anchoring strip to substrate according to manufacturer's instructions. Install floor sleeves and ropes/pipe beams as detailed and in accordance with manufacturer's recommendations.
   2. Supplier to provide and install all required steel supports for rope pipe beams to structural joists above.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Gymnasium Equipment:
   1. Porter Athletic: www.gillporter.com.
   2. Sportsfield Specialties: www.sportsfield.com.
   3. Aalco Mfg. www.aalcomfg.com.
   4. Jaypro: www.jayprosports.com.
   5. Performance Sports Systems: www.perfsports.com.
   6. American Athletic, Inc. www.americanathletic.com.
   7. Senoh: www.sportsimports.com.
   8. Approved substitute

B. Acceptable Equipment (high schools/middle schools):
   1. Floor Sleeves: Grout type floor sleeve (Porter #00870-200) with attached hinged cover, coordinate diameter of sleeve with Owner furnished volleyball standards. Cover shall conceal anchor screws and hinge shall be flush with top of wood Gym floor surface.
   2. Removable Wall Padding: Porter No. 00348-300 mats, 2-inch thickness, removable tumbling mats or equal of other acceptable manufacturer. Padding shall be constructed of foam filler covered with flame retardant, vinyl-coated polyester fabric with nap or loop pile ''Velcro" attachment strips on back. Color as selected from manufacturer's standard colors.

C. Acceptable Equipment (elementary schools):
   1. Volleyball Sleeves and Standards: Total of two (2) standards required. Porter No. 00941-000 with No. 870 floor sleeves or equal of other acceptable manufacturer. Location as directed by Architect.
   2. Climbing Ropes: Total of four (4) required. Porter No. 00113 hemp rope. Type I attachment or equal of other acceptable manufacturer. Provide No, 90320 pipe beam. Provide No. 10970 pipe attachment and No. 00110 safety guard for each rope.
   3. Climbing Rope Hoists: Total of one (1) required. Porter No. 00104 or equal of other acceptable manufacturer.

11 68 00 – PLAYGROUND EQUIPMENT AND STRUCTURES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Exterior Basketball Backstops, Goals, and Nets.
   2. Tetherball Posts.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. None.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Porter Athletic: www.gillporter.com.
   2. Jaypro: www.jayprosports.com.
   3. Aalco Mfg. www.aalcomfg.com.
   4. Performance Sports Systems: www.perfsports.com.
   5. Approved substitute.

B. Acceptable Products:
   1. Basketball Goals: Porter "Model No. 00164-000" or acceptable equivalent products of other manufacturer:
      a. 4-foot extended backstop with 4-1/2-inch diameter galvanized steel post.
      b. No. 00234-000 fan shaped aluminum backboard.
      c. No. 00201-H00 goal with 00161-000 plated chain net.

   2. Tetherball Posts: Porter "Model No. 007630-200" or acceptable equivalent products of other manufacturer:
      a. 2-3/8-inch galvanized steel post with cord anchor and tetherball.
      b. No. 00402-000 outdoor ground sleeves to fit posts.

11 79 00 – THERAPY EQUIPMENT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Installation and connections of Owner furnished items:
      a. Whirlpools in training room (high school).
      b. Ice makers in therapy and nurse's area.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. None.

D. Restrictions/Critical Criteria:
   1. Owner will furnish product data and rough-in catalog cuts for all items under this Section. Review electrical and mechanical rough-in shown on drawings. Coordinate exact locations of mechanical and electrical rough-in penetrations through the floor or walls.
   2. Receive, uncrate, place in proper location, and assemble all equipment covered by this Section. Set equipment accurately in place, level, and secure to floor. Provide connecting and attaching devices as required. Install items complete and adjust moving parts to operate smoothly.

PART 2 - PRODUCTS

A. Whirlpools and Ice Makers: Furnished by School District for installation by Contractor:
   1. Whirlpools: "Logan All Star Series" as manufactured by Logan, Inc.
   2. Ice Makers: "Ross/Temp Self-contained" #RF-151 SC as manufactured by Ross/Temp, Inc.

END OF SECTION

DIVISION 12 - FURNISHINGS

12 21 00 – HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Horizontal louver blinds with aluminum slats.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Samples for color selection.

D. Restrictions/Critical Criteria:
   1. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
      a. Thickness: 0.0072-inch minimum, copper free 5000 series magnesium aluminum alloy. Reprocessed metal, vinyl and plastic slats are prohibited.
      b. Width: 1-inch.
      c. Finish: One color.
   2. Headrail: Formed U-profile, 0.25-inch corrosion-resistant steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides. Provide manufacturer's standard caps or plugs in matching color.
   3. Bottom Rail: Formed 0.031-inch corrosion-resistant steel tube, with plastic or metal capped ends top contoured to match crowned shape of slat; with enclosed ladders and tapes to prevent contact with sill.
   4. Ladder Braid: UV stabilized polyester yarn with reinforced core.
   5. Cord Lock: Crash proof mechanism of 0.042-inch corrosion-resistant steel.
   6. Drum: Die-cast steel or engineered polymer.
   7. Cradle: 0.042-inch corrosion-resistant steel.
   8. Mounting Brackets: 0.048-inch corrosion-resistant steel with rivet-hinge safety lock front cover to permit removal of headrail without lateral movement.
   9. Manual Tilt Control: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
   10. Operation: Manual.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Hunter Douglas: www.hunterdouglas.com.
   2. Levolor: www.levelor.com.
   3. Springs Window Fashions Division, Inc. www.springswindowfashions.com.
   4. Approved substitute.

12 22 00 - ACOUSTICAL DRAPERIES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Acoustical draperies and related hardware in instrumental music rooms (used to modify acoustics of room).

B. Referenced Standards/Minimum Criteria:
   1. Fabricate draperies from flameproof material complying with latest requirements of Fire Department and State and local inspection authorities. Submit notarized affidavits concerning type of flameproofing used by the fabricator.
   2. Acceptable Fabricators: Acoustical drapery fabricator/installer shall be a firm that specializes in this type of work and which has been in this business continuously for a period of five (5) years.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options/fabric samples.

D. Restrictions/Critical Criteria:
   1. Draperies shall be 70% fullness, unlined with hidden grommets. Provide heavy-duty S hooks and 1-inch square fabric covered weights on each seam and each corner. Each drapery shall be tabled to assure exact length and hems.
   2. Provide wood blocking above ceiling for support of drapery track.

PART 2 - PRODUCTS

A. Acceptable Manufacturer - Drapery Track:
   1. One-way draw track with fascia along aluminum track with two-wheel trolleys:
      a. "Architrac Series 94003" by Kirsch: www.kirsch.com.
      b. Approved substitute.

B. Acceptable Manufacturer - Drapery Material:
   1. Virtually opaque, woven, 100% cotton FR treated velour that offers excellent sound absorption and noise reduction. A heavyweight fabric that weighs 25 oz. per linear yard:
      a. K.M. Fabrics "Memorable" by K.M. Fabrics: www.kmfabrics.com.
      b. Approved substitute.

12 24 13 – ROLLER WINDOW SHADES

PART 1 - GENERAL

A. Summary - Section includes:
   1. Window shades and accessories.
   2. Electric motor operators and motor controls.

B. Referenced Standards/Minimum Criteria:
   1. ASTM D4674 – Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments.
   2. NFPA 70 – National Electrical Code; most recent edition adopted by Authority Having Jurisdiction, including all applicable amendments and supplements.
   3. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
   4. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; current edition, including all revisions.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Selection samples.

D. Restrictions/Critical Criteria:
   1. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories; fully factory-assembled.
      a. Drop: Regular roll.

   2. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
      a. Blackout Shades: Block virtually all the light; Openness Factor equal to zero (0).
      b. Flammability: Pass NFPA 701 large and small tests.

   3. Roller Tube: As required for type of operation, extruded aluminum with end caps.
   4. Hembars and Hembar Pockets: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
      a. Style: Thermally sealed fabric pocket covering rectangular aluminum hembar.
      b. Blackout Shades: Provide a slot in bottom bar with wool-pile light seal.

   5. Motor Operation: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed to UL 325.
   6. Wall-Mounted Controls: UV stabilized visible parts meeting ASTM D4674; provided by shade manufacturer.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Manually Operated Roller Shades:
      a. BTX Intelligent Fashion, LLC: www.btxinc.com.
      b. Draper, Inc. www.draperinc.com.
      c. Hunter-Douglas: www.hunter-douglas.com.
      d. MechoShade: www.mechoshade.com.
      e. Approved substitution

   2. Motorized Roller Shades, Motors and Motor Controls:
      a. BTX Intelligent Fashion, LLC: www.btxinc.com.
      b. Draper, Inc. www.draperinc.com.
      c. Hunter-Douglas: www.hunter-douglas.com.
      d. MechoShade: www.mechoshade.com.
      e. Approved substitution

12 31 00 – ROLLING STORAGE UNITS

PART 1 - GENERAL

A. Summary - Section includes:
   1. High-density rolling storage units.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Color options for end panels.

D. Restrictions/Critical Criteria:
   1. Architect to coordinate additional floor structure required to support rolling storage units if located on structural floor.

PART 2 - PRODUCTS

A. Acceptable Manufacturers – High Density Rolling Storage Units:
   1. Aurora Storage Products: www.aurorastorage.com.
   2. Lundia: www.lundiausa.com.
   3. Spacesaver Corp.: www.spacesaver.com.
   4. TAB Storage: www.tab.com. Approved substitute

B. Type:
   1. High Density Mobile Storage System with single-faced stationary and double-faced mobile units. Provide complete system with low profile track and high-profile carriage with 1,000 lb. capacity per lineal foot. Provide 3/4-inch plywood flooring panels (fire treated) between tracks. Each unit to be provided with six (6) adjustable shelves. Shelves shall be 1-1/4-inch painted particleboard or steel. Provide closed upright as end panel for each section.
   2. Size and Configuration: Nominal 7'-0" high actual storage x width.
   3. Operation: Manufacturer's standard mechanical assist system which allows one (1) pound of effort to move 3,000 pounds of load.

12 32 00 – PLASTIC LAMINATE FACED CASEWORK

PART 1 - GENERAL

A. Summary - Section includes:
   1. Plastic laminate cabinets, counters, shelving, and casework.
   2. Plastic laminate countertops
   3. All special units such as file drawer units, open shelving, and knee space drawers.
   4. Steel supports, hardware, and accessories.
   5. Maple countertops at high schools.
   6. Galvanized steel countertops and shelves at high schools.

B. Referenced Standards/Minimum Criteria:
   1. Architectural Woodwork Institute (AWI)
   2. National Particleboard Association (NPA)

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Color options (full range) for plastic laminate and PVC edging (full range).
   4. Submit one full size sample of finished base cabinet and/or wall cabinet unit complete with hardware, doors, and drawers, without finish top, if requested by Architect.

D. Restrictions/Critical Criteria:
   1. Materials:
      a. Use 3 mm PVC edging for door and drawer front edges.
      b. Use 3 mm PVC edging for all front and backsplash edges of countertops.
      c. Use 1 mm PVC edging for cabinet body edges and coatbox edges.
      d. All countertops 1-1/8-inch medium density particleboard - with 0.050-inch plastic laminate top and backer sheet on underside of countertop.
      e. All particleboard - 45 lbs. per cubic foot
      f. Interior cabinet liner to be 0.020-inch thick thermally fused melamine laminate.
      g. Acid Resistant plastic laminate shall be 0.050-inch thickness Wilsonart "Chemsurf Chemical Resistant Decorative Laminate".

h. Sub-tops and bottoms of cabinets shall be particleboard, 3/4-inch thick. Bottom shall be laminated on the interior with melamine laminate with a backer sheet on the unexposed surface. The bottom surface of upper cabinets shall be melamine laminate cabinet liner.

i. Cabinet ends shall be particleboard, 3/4-inch thick. Concealed exterior with a melamine backer sheet. Exposed cabinets ends shall be laminated with vertical grade decorative plastic laminate, 0.030-inch thick. Holes shall be drilled for interior adjustable shelf clips.

j. Standard recessed cabinet back shall be 1/4-inch thick prefinished hardboard glued into cabinets. Laminate to match cabinet interior. All sink cabinets shall have split back, removable from inside. Exposed exterior back on fixed cabinets shall be particleboard, 3/4-inch thick, laminated with high pressure, vertical grade, 0.030-inch thick, High Pressure Decorative Laminate.

k. Cabinet Doors and Drawer Fronts: Particleboard, 3/4-inch thick, shall be laminated with vertical grade decorative plastic laminate on the exposed surface and melamine laminate cabinet liner on the interior surface.

l. Drawers: Sides, back and sub-front, shall be particleboard, 1/2-inch thick, laminated with melamine laminate. The back and sub-front shall be doweled and glued into the sides. No staples or nails permitted. Drawer bottom to be 1/4-inch thick, prefinished hardboard let into sub-front, sides and back. Paper storage drawers shall be heavy-duty 3/4-inch particleboard construction with 100 pound full extension slides, plywood reinforcement stiffener at bottom and a retaining hood at the rear of each drawer.

m. Vertical Dividers: Particleboard. 3/4-inch thick, shall be laminated with melamine laminate cabinet liner, both sides.

n. Wire Grille Doors: Manufacturer's standard wire grille door with hinges, label holder, and padlock eye. Epoxy power coated hinge and wire grille door.

o. Music Storage Unit Fixed Shelving: Units shall have high density polyethylene molded surface with integral ventilation grooves front to back on fixed and bottom shelves. Provide separate high-impact-resistant extruded PVC nosing on front edge of fixed and bottom shelves.

p. Fixed Intermediate and Adjustable Shelves: Particleboard, 3/4-inch thick, laminated on both sides with melamine laminate cabinet liner (closed door cabinets). Adjustable shelves up to 30 inches wide shall be 3/4-inch thick. Shelves 30-inches to 36-inches wide shall be 1-inch thick. Casework units wider than 36-inches shall have vertical dividers. Open shelf unit cabinet shelves shall be laminated with vertical grade, 0.030-inch thick, plastic laminate.

q. Maximum span for wood or plastic laminate covered shelves is 36-inches between shelf standards.

r. Maple Countertops and Backsplash: 1-1/4-inch thick, Northern Hard White Maple edge grain glue-laminated. Provide two (2) coats clear penetrating oil. Rabbet 3/4-inch thick Maple backsplash into countertop.

s. Galvanized Steel Countertops and Shelves: 28 gauge galvanized sheet steel bent and wrapped 2-inches to underside of horizontal surfaces. Core shall be 1-1/4-inch thick plywood sheet for countertops, 3/4-inch thick plywood for shelves and backsplash. Galvanized sheet steel shall be adhered to core with contact cement. File smooth all edges of steel not bent. Provide melamine laminate balance sheet to underside of plywood countertop, backsplash, and shelf.

2. Acceptable Joinery/Construction:
   a. Tops and bottoms shall be joined to cabinet ends using a minimum of six (6) dowels for twenty-four (24) inch deep cabinets and a minimum for four (4) dowels for twelve (12) inch deep cabinets. All dowels shall be hardwood laterally fluted, with chamfered end. Internal cabinet components such as fixed horizontals, rails, and vertical shall be doweled in place. Dowels shall be securely glued and cabinets clamped under pressure during assembly to assure secure joints and cabinet squareness.

3. Hardware and Accessories:
   a. Hinges: 5 knuckle 2-3/4-inch, recessed in box wall type, 0.095-inch thick steel with standard color epoxy powder coat or metallic finish. Hinges shall have a minimum of 8 leaf and edge fastening locations. Doors 48-inches and over in height shall have three (3) hinges per door.
   b. Door and Drawer Pulls: Epoxy powder coat on metallic finish metal wire pulls.
   c. Drawer Suspensions: Each drawer equipped with one pair of ball bearing nylon roller suspensions which shall be self-closing from a four (4) inch extension, have a minimum load capacity of one hundred (100) pounds and be of zinc coated rolled steel. Knee space drawers shall be equipped with suspensions with a minimum load capacity of fifty (50) pounds each. Heavy-duty paper storage and file drawers shall be equipped with full extension suspensions with a minimum load capacity of one hundred fifty (150) pounds each and 200 pound capacity at full extension lateral file drawers.
   d. Drawer Stops: Drawers shall be equipped with two (2) drawer stops attached to the cabinet ends. The cabinet drawer stops shall be metal with attached rubber bump and be installed to prevent the drawer face from touching the cabinet body when the drawer is in a closed position.
   e. Door Catches: Magnetic type with a minimum ten (10) pound pull, attached with screws and slotted for adjustment. Provide thumb latch on inactive leaf on pair of doors.
   f. Shelf Supports: Heavy-duty, self-locking nylon or polycarbonate, designed for installation in pre-drilled holes in cabinet ends and vertical partitions. Supports shall carry up to 1,500 pounds without failure.
   g. Door and Drawer Locks: Five (5) disc tumbler, cam type, keyed alike or differently and master keyed as directed by School District. Each different lock shall be furnished with two (2) keys. Fifty (50) lock changes available. All drawers and doors to have locks.
   h. Chain Bolts: 3 inches long, with 18-inch pull and angle strike to secure inactive door on cabinets over 72-inches in height. Elbow catches shall be used on inactive doors up to and including 72-inches in height.

i. Tote Trays: Heavy-duty vacuum formed plastic type with top rim and pull. Each tray shall be tan or ivory in color and equipped with a plated steel label holder.
j. Coat Rods: 1-1/4-inch, 14 gauge chrome plated steel.
k. Index Followers: Steel plate and rod file followers recessed in bottom of file drawers.
l. Mirrors: 1/4-inch thick polished mirror plate attached with plastic clips and screws.
m. Conduit sleeves: Provide plastic grommets in tops of workstations.

PART 2 - PRODUCTS

A. Acceptable Casework Manufacturers:
1. Case Systems: www.casesystems.com.
2. Frontier Door and Cabinet: www.frontierdoor.com.
3. LSI Corporation: www.lsicasework.com.
4. Sidney Millwork Company: www.sidneymillwork.com.
5. Salina Planing Mill, Inc.: www.salinaplaningmill.com.
6. TMI Systems Design Corporation: www.tmisystems.com.
7. Approved substitute.

B. Acceptable Plastic Laminate Manufacturers:
1. Formica: www.formica.com.
2. Laminart: www.laminart.com.
3. Nevamar: www.nevamar.com.
4. Panloam: www.panolam.com.
5. Wilsonart: www.wilsonart.com.
6. Approved substitute.

12 35 53 – LABORATORY COUNTERTOPS AND DROP-IN SINKS

PART 1 - GENERAL

A. Summary - Section includes:
1. Epoxy resin countertops and drop-in sinks in science labs and prep rooms.

B. Referenced Standards/Minimum Criteria:
1. None.

C. Submittals Required:
1. Product data.
2. Shop drawings.
3. Color options.

D. Restrictions/Critical Criteria:
   1. Field Measurements: Verify measurements before beginning final fabrication. Countertops and sinks must conform to casework below and must be neatly fitted around openings, pipes, or obstructions.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Epoxy Resin Countertops and Drop-in Sinks:
   1. Laboratory Design & Supply: www.labds.com.
   2. Epoxy Tops: www.epoxytops.com.
   3. Kewaunee Scientific Equipment Corp. www.kewaunee.com.
   4. Durcon Company, Inc. www.durcon.com.
   5. Fisher Scientific, Inc. www.fishersci.com.
   6. Approved substitute.

B. Epoxy Resin Countertops:
   1. General: 1-inch thick solid black molded epoxy resin with integral molded back and end splashes. Provide cutouts in countertop as required for sinks and fittings.

C. Drop-In Epoxy Resin Sinks:
   1. General: Provide sinks, outlet, stopper, overflow and tail piece. Traps, vents, and drain lines from trap to rough-in shall be provided in accordance with requirements of mechanical.
   2. Drop-In Sinks: One-piece black epoxy resin with cover corners, sides, and bottom with drain cutout. Minimum inside dimensions shall be 25-inches x 15-inches x 10-inches deep.
   3. Sinks at handicap locations shall have minimum inside dimensions of 18-inches by 15-inches by 5-inches deep.

12 35 83 – MUSICAL INSTRUMENT STORAGE

PART 1 - GENERAL

A. Summary - Section includes:
   1. Musical instrument storage casework.

B. Referenced Standards/Minimum Criteria:
   1. ANSI A208.1 – Particleboard.
   2. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.
   3. ASTM C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   4. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
   5. ASTM E795 – Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

6. Audio Engineering Society (AES): AES-4id – AES information document for room acoustics and sound reinforcement systems – Characterization and measurement of surface scattering uniformity.
7. Builders Hardware Manufacturers Association (BHMA): ANSI/BHMA A156.9 – Cabinet Hardware.

C. Submittals Required:
1. Product data.
2. Shop drawings.
3. Color options.

D. Restrictions/Critical Criteria:
1. Particleboard: ANSI A208.1, minimum 43 lb/cu. ft. density, composite products and adhesives, with no urea formaldehyde added.
2. Fire Rated Particle Board: ANSI A208.1, minimum 45 lb/cu. ft. density ASTM E-84 class 1.
3. Plywood: APA standards PS1-98 section 5.7.4 or 5.7.1 or ANSI /HPVA HP-1-2004 Panel provide with HDF skins to prevent grain telegraphing.
4. Particleboard Thermoset Panels: Particleboard finished with thermally-fused polyester surfacing on both sides meeting performance properties of NEMA LD 3 for VGS grade, edge-banded. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.
5. Particleboard Thermoset Panels: Particleboard panel with no formaldehyde added 3/4-inch thick finished with thermally-fused polyester surfacing on both sides meeting performance requirements of NEMA LD 3 for VGS grade, edge-banded. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.
6. Polyethylene Shelves: High-density, one-piece, blow-molded or polyethylene, with radiused front edge, for abuse-resistant shelves. Same color throughout will not show scratches.
7. PVC Edge Banding: Radiused PVC extrusions, 1/8-inch thick.

PART 2 - PRODUCTS

E. Acceptable Manufacturers/Products:
1. "UltraStor Storage Cabinets" by Wenger Corporation: www.wengercorp.com.
2. Approved substitute.

12 45 00 – FIXED BLEACHER SEATING

PART 1 - PRODUCTS

A. Summary - Section includes:
   1. Fixed bleacher seating for use in swimming pool areas.
      a. Fixed seating system shall be individual seats comprised of seat and deck components for attachment to concrete understructure

B. Referenced Standards/Minimum Criteria:
   1. International Building Code Standard: Comply with requirements of IBC / ICC 300, Chapter 4 "Standard for Bleachers, Folding and Telescopic Seating and Grandstands Assembly Seating", except where other requirements are indicated.
   2. Fixed bleacher seating shall be designed to support, in addition to its own weight, and the weight of added accessories, a uniformly distributed live load of not less than 100 lbs. per sq. ft. of gross horizontal projection.
   3. Sway force applied to seats shall be 24 lbs. per linear ft. parallel to the seats and 10 lbs. per linear ft. perpendicular to the seats. Sway forces shall not be considered simultaneously applied.
   4. American Institute of Steel Construction (AISC), American Iron and Steel Institute (AISI) and Aluminum Association (AA) design criteria shall be the basis for calculation of member sizes and connections.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Seating Area: Refer to drawings, concrete attached.
   2. Dimensions:
      a. Row Spacing: As shown on drawings.
      b. Rise per row: Approximately 16-inches.

   3. Understructure System: Steel supports and frames shall be constructed of formed steel shapes of the size and shape necessary to support the design loads.

4. Seat Systems:
   a. Plastic modular 18-inch individual seats in 10-inch deep models. Seating to be scuff resistant injection molded high density polyethylene plastic.
      1) Seat modules supplied shall be of a high aesthetic design using multiple textures, style lines and a waterfall front. The rear of the seat shall be slightly curved to eliminate the straight-line appearance and include a moderate seat contour and texture to enhance spectator comfort.
      2) Seating design shall be molded to achieve a finished end appearance without the use of end caps. The rear of the seat shall include a smooth wall allowing for the deck to be easily swept clean without obstruction.
      3) Seat heights shall be maintained at a minimum of 16-3/4-inches. Lower seat heights which detour from spectator comfort will not be accepted.
      4) Foot space shall be maximized for spectator comfort and provide a minimum of 22-inches when measured with a 10-inch module.
      5) Architect shall select seating colors from manufacturer's standard colors.
      6) Securely fasten each seat to the nose beam using a 10-gauge formed steel bracket and locking hardware. Adjacent seating shall be interlocked together along the full perimeter eliminating any fore or aft movement or the potential of any pinching hazard.
      7) Seat modules shall be designed to support a uniform load of 600 lbs. per seat and a concentrated load of 150 lbs. over 4-square inches.

   b. Blow-Molded Seats: Supply plastic modular 18-inches individual seats in 10-inch deep models. Seating to be scuff resistant blow molded high density polyethylene plastic.
      1) Seats shall be blow-molded, double-walled, high density, impact resistant, UV stabilized, linear polyethylene available in 15 bright standard colors.
      2) Each module to be bracket supported with concealed mounting hardware attachment for rigidity.
      3) Modules shall allow a full 26-1/4-inches unobstructed area for foot room comfort and cleaning. Modules with external ribs or multiple piece modules are not acceptable.

   c. Nosings: Nosing shall be one piece, formed, 14-gauge steel with a minimum G-60 pre-galvanized finish.
   d. Rear Risers: Rear riser shall be one piece, formed, 14-gauge steel with a minimum G-60 pre- galvanized finish.

PART 2 - PRODUCTS

A. Acceptable Manufacturers – Fixed Bleacher Seating:
   1. Model "Infinity" as manufactured by IrwinTelescopic Seating Company: www.irwinseating.com.
   2. Approved substitute.

12 61 00 – AUDITORIUM SEATING

PART 1 - GENERAL

A. Summary - Section includes:
   1. Auditorium seating in high schools.

B. Referenced Standards/Minimum Criteria:
   1. Upholstery to meet following criteria:
      a. Flame Resistance: Meet requirements of the following fire codes: California Technical Bulletin 117, Section E CS-191-53, Class 1 BIFMA FF1-78 ASTM E84, Class A NFPA 260-A, 1983 UFAC Class 1
      b. Ultraviolet Stability: Minimal degradation at 350 hours (AATCC 16 - Xeno Face-O-meter).
      c. Surface Abrasion, ASTM-D-1175 (Wyzenbeek): Heavy-duty, can exceed 260,000 double rubs.
      d. Colorfastness to Light, AATCC Test Method 16-1981: 40 hours, Class 4 min.
      e. Colorfastness to Crocking, AATCC Test Method 8-1981: Wet: Class 4 min.
      f. Dry: Class 3 min.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Extra Materials: At the completion of the project, furnish the following items to the Owner:
      a. Five (5) seat backs.
      b. Five (5) seat bottoms with hardware for retracting seats.
      c. Three (3) yards of each fabric color selected or five (5) yards if one fabric color is selected.

PART 2 - PRODUCTS

A. Acceptable Manufacturers - Auditorium Seating:
   1. Irwin Seating Company: www.irwinseating.com.
   2. Hussey Seating Company: www.husseyseating.com.
   3. Approved substitute.

B. Manufacturer and Type: Hussey Seating Company "Concordia C-05110" or equal of other acceptable manufacturer. Seating shall include padded upholstered seats and backs, plastic laminated arms, injected molded outerback, plastic laminate end panels, and conventional incandescent aisle lights in end panels. Provide drop arms on end aisle seats in accordance with ADA accessibility standards. Provide identification plates for each row and seat.

C. Upholstery Fabric: Standard fabrics by Hussey Seating Company.
   1. Content: 100% Marquesa Lana (Polyolefin)
   2. Weight: 16 oz. per linear yard, backed.
   3. Construction: 13 warp ends per inch, 13 fill picks per inch, 2,400 denier solution-dyed.
   4. Standard Width: 54-inches
   5. Backing: Acrylic.

12 66 13 – TELESCOPING BLEACHERS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Telescoping bleachers and accessories in gymnasiums.

B. Referenced Standards/Minimum Criteria:
   1. Conform to 2015 IBC for aisle layout and railing requirements.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.
      a. Provide detailed locations of bleachers rollers for coordination of wood blocking installation below wood gymnasium flooring system.

   3. Color selection samples.

D. Restrictions/Critical Criteria:
   1. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
      a. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
      b. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
      c. Operation: Motor operated.

   2. Design Loads: Design to withstand the following loading conditions:
      a. Live Load on Structural Supports: 100 psf, minimum, of gross horizontal projection.
      b. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot.
      c. Lateral Sway Stress on Structural Supports: 24 pounds per linear foot of seat plank.
      d. Perpendicular Sway Stress on Structural Supports: 10 pounds per linear foot of seat plank.

3. Dimensions:
   a. Rows: As shown on Drawings.
   b. Rise Per Row: 10-inches.
   c. Row Depth: 22-inches.
   d. Seat Height Above Tread: 6-inches.

4. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
   a. Design so that each row carriage so that it will individually support the design loads and is self-supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
   b. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
   c. Bolting: Use lock-washers or locknuts.
   d. Wheels: Minimum 5-inch diameter by 1-1/8-inch wide, with non- marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
   e. Finish: Manufacturer's standard enamel or powder coating.
   f. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
   g. Unlocking: Automatically unlock all rows before engaging retraction mechanism.

5. Motor Operation: Manufacturer's standard drive mechanism, using motor adequately sized for the purpose.
   a. Provide UL listed electrical components and wiring.
   b. Controls: Start, Stop, Forward, and Reverse in a single control unit.
   c. Control Station: Removable plug-in low-voltage pendant station, with first-row plug-in location for each motor.
   d. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
   e. Provide all wiring internal to bleacher units, to junction box located where indicated; ensure that wiring is not energized except during operation.
   f. Electrical Characteristics: 120V, single phase, 60 Hz.
   g. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30-inches wide is acceptable.

PART 2 - PRODUCTS

A. Acceptable Manufacturer:
   1. Interkal, LLC. www.interkal.com.
   2. Approved substitute.

12 93 13 – SITE FURNISHINGS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Bicycle racks.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Product data.
   2. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Pipe: Galvanized Carbon steel, ASTM A53/A53M, Schedule 40.
   2. Outdoor Bicycle Racks: Device allows user provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
      a. Style: Serpentine rack formed from a continuous round pipe.
      b. Capacity: 11 bicycles.
      c. Accessories: In-ground grout cover.

PART 2 - PRODUCTS

A. Acceptable Manufacturers/Products:
   1. Provide "Model No. RB11" by AAA Ribbon Bike Rack Co.: www.ribbonrack.com, or comparable product by one of the following:
      a. Columbia Cascade Company: www.bicycle.columbia-cascade.com.
      b. Madrax, Inc. www.madrax.com.
      c. Kay Park - Rec Corp. www.kaypark.com.
      d. Huntco Supply, Inc. www.huntco.com.
      e. Approved substitute.

END OF SECTION

DIVISION 13 – SPECIAL CONSTRUCTION

13 11 00 – SWIMMING POOLS AND EQUIPMENT

PART 1 - GENERAL

A. Summary - Section includes:
   1. Swimming pools.
   2. Pool deck construction including finishes, caulking, drains, etc., installation of anchors or deck equipment and anchors.
   3. Pool piping and pool fittings: Fresh water connection to pools and wastewater connection from filter.

B. Referenced Standards/Minimum Criteria:
   1. Comply with the following standards:
   2. National Spa and Pool Institute (NSPI):
   3. Minimum Standard for Public Swimming Pools.
   4. Minimum Standard for Public Spas.
   5. All local building and health codes.
   6. National Electrical Code (NEC), Article 680.
   7. National Sanitation Foundation (NSF): Seal of approval program.
   8. American Society for Testing and Materials (ASTM): Specifications referenced herein.
   9. Department of Public Health
   10. County and City Building Codes.
   11. Gunite Contractors Association (CGA): Technical Publication.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Color options/samples.
   4. Valve charts.
   5. Concrete design mix.
   6. Pool interior finish materials.
   7. Design data.

D. Restrictions/Critical Criteria:
   1. Architect shall employ a swimming pool consultant who shall work with representatives of the School District to design the swimming pools and determine appropriate materials, equipment, and operational requirements.
   2. Pool Contractor Qualifications: Must have at least five (5) years experience in the construction of the type of swimming pool herein specified and must have successfully completed a minimum of six (6) pools of this type, each with a water surface area not less than is to be constructed in this project. If necessary, investigator will determine if pools have been successfully completed and operational for a minimum of two (2) years. Pool contractor shall furnish complete evidence that they have facilities, equipment, personnel and schedule abilities to complete all phases of this project.

PART 2 - PRODUCTS

A. Acceptable Pool Contractors:
   1. High Country Pools, Fort Collins, Colorado: www.highcountrypools.com.
   2. Associated Pool Builders, Bismark, North Dakota: www.associatedpool.com.
   3. Monarch Pools, Denver, Colorado: www.monarchpools.com.
   4. Front Range Pools, Colorado Springs, Colorado: www.frontrangeaquatech.com.
   5. Approved substitute

B. Acceptable Materials and Equipment:
   1. To be determined.

13 34 16 - EXTERIOR BLEACHERS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Exterior bleachers at running track/football field.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Shop drawings.
   2. Product data.
   3. Color options.

D. Restrictions/Critical Criteria:
   1. Design Requirements: Bleacher shall be designed by the manufacturer to support, in addition to its own weight, a uniformly distributed live load of not less than 120 pounds per square foot of gross horizontal projection of the bleachers. Seat and foot board members shall be designed to support no less than 120 pounds per square foot. The bleachers shall be designed to resist, with or without live load, a horizontal wind load of 30 pounder per square foot of gross vertical projection. They shall also be designed to resist, in addition to the live load, sway forces applied to the seats; in a direction parallel to the direction of the seat planks, 24 pounds per lineal foot of seat plank; and separately; in a direction perpendicular to the direction of the seats, 10 pounds per linear foot of seat plank.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Dant Clayton: www.stadiumbleachers.com.
   2. Outdoor Aluminum: www.outdooraluminum.com.
   3. Sturdisteel: www.sturdisteel.com.
   4. Bleachers International: www.getseating.com.
   5. Approved substitute.

B. Description:
1. Manufacturer and Type: Dant Clayton, non-elevated, ZA-155 Standard Series, five (5) rows, or equal of other acceptable manufacturer. Total of five (5) sections required for total length of 75'-0".
2. Component Construction Materials: Extruded aluminum components shall be 6063-T6 alloy and temper with minimum wall thickness of 0.078-inches. Aluminum shall have clear anodized finish.
3. Aisles: None
4. Guard Rail System: At rear and side to meet IBC requirements.
5. Riser per Row: 8-inches
6. Depth per Row: 24-inches
7. Seatboards: 2" x 10" nominal aluminum, no backrest.
8. Footboards: 2" x 10" nominal aluminum.
9. Support Structure: Dant Clayton "Standard Series Aluminum Frame".
10. Hardware: Tamper resistant.
11. Base: Ground sill skids for attachment to concrete mounting bases.
12. Capacity: 250 seating (18-inches per seat).

13 34 23 – GAZEBOS, PAVILLIONS, TRELLISES, AND OTHER OPEN-AIR COVERED STRUCTURES

PART 1 - GENERAL

A. Summary - Section includes:
1. Labor, materials, and equipment necessary for the installation of metal shelter(s).
   a. Work shall include, but not be limited to the following: excavation; engineering calculations and design for the footings and shelter; layout; and the furnishing and installing of shelters and related equipment, including all appurtenances and accessories as required for a full and complete installation.

B. Referenced Standards/Minimum Criteria:
1. Shade structures must comply with the latest revision of applicable codes and regulations including the International Building Code IBC 2015; American Society of Testing Materials (ASTM); American Welding Society: Structural Welding Code AWS D1.1: Symbols for Welding and Nondestructive Testing AWS2.3; American Institute of Steel Construction (AISC): Specifications for design, fabrication and erection of structural steel.

C. Submittals Required:
1. Product data.
2. Shop drawings.
3. Samples for color selection.
4. Installer qualifications.

D. Restrictions/Critical Criteria:
1. Shelters must be engineered to withstand snow and wind loads.

E. Acceptable Manufacturers/Products:
1. Superior Recreation Products- Shelters by All Around Recreation LLC: www.allaroundrec.com.
2. Icon Shelter Systems by Recreation Plus, Ltd. www.recreationplus.com.
3. Approved equal.

F. Design and Fabrication:
1. Shelter unit submitted for consideration shall be equivalent in design, size, height, appearance, color, and construction detail of the specified structure.
2. Fabricate using open "I" beams. Design using open "Cees" or open channels shall not be accepted. All open members shall be covered or boxed to present a tubular appearance. Tapered columns shall not be accepted.
3. Seamed metal roof systems shall have the ribs or seams running with the slope of the roof.
4. Field fabrication and labor shall be kept to a minimum by the use of premanufactured parts. Suppliers shall list all materials and parts that must be field cut, custom fit and field fabricated. Roof deck and/or panel work shall be detailed as to fieldwork required.
5. Foundation and anchor bolt configurations shall be of the same "footprint" as that of the shelter unit, specified. Method of column anchoring shall be equivalent to that of the shelter unit specified, in most cases, a single precast anchor bolt inside each column will be the only acceptable method.

G. Warranty:
1. Provide a five-year warranty on all labor and materials shall be provided by the Contractor.
2. Provide a supplemental warranty from the manufacturer shall be provided for a period of 10 years on all structural integrity of the steel from date of substantial completion.

H. Design Loads – Shelters:
1. Shelters shall be designed in strict accordance with the International Building Code IBC (current edition) using a minimum Snow Load of 20 psf, a minimum Wind Load based on a 115 mph wind speed. The shelter shall be designed as a Space Frame using three dimensional (3-D) structural analysis to determine member loads and forces. The structure shall be surface mounted over internal anchor bolts.

I. Structural:
1. All structural framing (except the compression ring) shall be structural ASTM A500-GRADE B cold formed, electric resistance welded tubing with cover plates to form a clean, neat appearance and no place for bird nesting. Welded "Cee" sections will not be acceptable. The compression ring shall be structural steel plate. Since all connections will bolt together, field welding shall not be required. Bolts shall be concealed within the tubing where possible. All steel members shall be designed in strict accordance with the requirements of the "American Institute of Steel Construction" (AISC) Specifications and the "American Iron and Steel Institute" (AISI) Specifications for Cold Formed Members. All structural field connections shall be designed and made with High Strength bolted connections using ASTM A325 structural bolts.

2. All shop-welded connections shall be designed and made in strict accordance with the requirements of the "American Welding Society" (AWS) Specifications. Structural welds shall be made, tested, and certified in accordance with AWS requirements.

J. Finish Coating:
   1. The steel frame shall be powder coated according to the following procedure:
      a. The steel shall be shot blasted to near white condition, removing all oil, grease, scale, and rust.
      b. Zinc-rich gray powder coating primer shall be applied over the bare metal.
      c. The finish coat shall be TGIC-polyester powder coating with 3-6 mil thickness.
      d. Color shall be selected from the manufacturer's powder coating color chart.

   2. Structure and Size: The structure and dimensions shall be as shown on drawings.

K. Structure Frame:
   1. Square, hipped-roof shelter with 6:12 roof pitch.
      a. Structural steel columns.
      b. Purlins, tension, and truss members shall be structural steel.

L. Roofing System:
   1. Metal roofing panels shall be 24-gauge painted, galvanized standing seam roof decking 12-inches wide with 1-inch high battens. Ribs shall run with the pitch of the roof for proper drainage. At the eave, the panels shall be field cut and turned down to form a fascia edge.
   2. Panels and matching trim shall be pre-painted with a Kynar 500 paint system. Color as selected by Architect. A complete matching trim package shall be supplied.
   3. Roofing underlayment, fasteners, and technical manual shall be supplied by the manufacturer.

END OF SECTION

DIVISION 14 - CONVEYING SYSTEMS

14 24 00 – HYDRAULIC ELEVATORS

PART 1 - GENERAL

A. Summary - Section includes:
   1. Holeless Hydraulic elevator and related equipment.

B. Referenced Standards/Minimum Criteria:
   1. ASME/ANSI Safety Code for Elevator and Escalators.
   2. ASME A17.1 and Applicable State and Local Codes.

C. Submittals Required:
   1. Shop drawings.
   2. Color options/samples of elevator cab.
   3. Control button graphics.
   4. Quality Control Submittals: Submit written report of required operations test at completion of the project.

D. Restrictions/Critical Criteria:
   1. Contractor to furnish maintenance and call-back service of equipment provided for a period of one (1) year after Date of Substantial Completion. This service shall include regular examination of the installation by competent and trained employees of elevator manufacturer and shall include necessary adjustments, greasing, oiling, cleaning, supplies, and parts necessary to keep the equipment in good operation; except such parts required due to mis- use, accidents, or negligence not caused by the manufacturer.
   2. General: Elevator shall be installed according to manufacturer's instructions and all reference standards.
   3. Wiring, Piping, and Oil: Provide necessary wiring in the hoistway in accordance with the NEC, to connect the operating buttons and switches to the control board in the power unit. Wiring shall be in rigid conduit or electrical metallic tubing except to moving apparatus which shall be connected by short lengths of flexible conduit. Provide necessary pipe and fittings to connect the power to the jack unit, and oil of the proper grade. Underground conduit and piping shall be adequately protected against corrosion.
   4. The elevator manufacturer shall make, in the presence of the Architect and School District, a running speed test with full maximum load on the elevator car to determine whether the elevator equipment as installed, meets the speed, capacity, and other requirements of the specifications.

PART 2 - PRODUCTS

A. Acceptable Manufacturers:
   1. Schindler Elevator Corp. www.schindler.com.
   2. Otis Elevator Co. www.otis.com.
   3. Kone, Inc. www.kone.us.
   4. Approved substitute

B. Elevator Equipment:
   1. Manufacturer and Model: Schindler 300A Low-rise Hydraulic Elevator.
   2. Type: Hydraulic, holeless.
   3. Elevator Type: Passenger.
   4. Floors Served: 2 or 3.
   5. Travel: To be determined by design.
   6. Number of Landings: 2 or 3.
   7. Number of Openings: 2 or 3 in line.
   8. Power Supply: 480V, 3 phase, 60 cycle, reduced voltage starting (verify with Electrical Design Engineer).
   9. Capacity: 2,000 lb.
   10. Minimum Up-Speed: 100 feet per minute fully loaded.
   11. Car Size: 5'-8" X 4'-3".
   12. Operation: Simplex - selective collective.
   13. Hoistway Entrance: Hollow metal.
      a. Opening Size: 3'-0" wide by 7'-0" high single speed, side opening.
      b. Finish: Baked enamel.
      c. Door Operation: DC power.
      d. Signals: Illuminated car and hall pushbuttons, hall pushbuttons key operated; light up position indicator in car, 2 car riding lantern and gongs in entrance columns; NEII handicapped package.

   14. Leveling: Two-way leveling.
   15. Emergency Lighting: Automatic emergency light and alarm system.
   16. Special Features Required: Exhaust fan, photo electric eyes, protective pads for cab walls, oil viscosity control, low oil control. Emergency power back-up to provide for return to Level 1 and open door if power outage.
   17. Sill Angle: Steel sill angle, standard of manufacturer for groutless mounting.

C. Elevator Car: Car shall be provided with painted steel entrance columns and transoms; plastic laminate side walls and rear returns; #4 stainless steel front returns and transom; stainless steel handrails on three (3) sides; base of black plastic laminate; protection pads and buttons; one- speed exhaust fan and false ceiling with fluorescent tubes above. Floor covering to be as selected by the school district.

END OF SECTION

DIVISION 21- FIRE SPRINKLER SYSTEMS

SECTION 21 00 00

INTRODUCTION

PART 1 – GENERAL

A. OVERVIEW

1. This guide line specification is for the Consulting Engineers and outlines minimum requirement for the District. The Consulting Engineer should apply these guidelines consistent with the budget constraints. The Consulting Engineer must select among the systems, size and specific equipment and materials within the budget and design limits. The guidelines are based upon considerable experience with the purpose of providing the best value for the available money.
2. The applicable provisions elsewhere in Division 21, 22 and 23 shall apply.
3. Related Requirements:
    a. Basic Mechanical Regulations: Section 23 00 03
    b. Basic Mechanical Materials and Methods: Section 23 00 04
    c. Mechanical Nose and Vibration: Section 23 05 48
    d. Mechanical Identification: Section 23 05 53
    e. Mechanical Insulation: Section 23 07 00
    f. Demonstrations: Section 23 05 95
    g. System Starting: Section 23 05 97
    h. Project Close-Out: Section 23 90 00

B. DESIGN

1. The Consulting Engineer is required to provide a complete and workable design. The Consulting Engineer is responsible and accountable for his/her work. If in the opinion of the Consulting Engineer any portion of these guideline specifications or system performance function will not be complied with, the Engineer will notify the District in writing.
2. Provide a complete operable system designed and installed in accordance with applicable local, state, federal and jurisdictional codes, enforcement agencies and insurance or underwriting agencies. Comply with NFPA 13. Systems shall be drainable with proper drainage devices and drain terminations to properly sized receptors within the building.
3. The Fire Protection Contractor shall be responsible for the final design, layout, all materials, equipment and labor for the complete, approved, and operational installation of the fire protection systems.
4. The Fire Protection Contractor shall be responsible for coordinating any interferences with other crafts and space limitations for the satisfactory installation of all fire protection piping and equipment.
5. For hydraulically designed systems, the hydraulic calculations shall accompany the working plans submitted and shall include a summary sheet, detailed work sheets and a graph sheet; per NFPA Standard 13. Margin of safety for available water flow and pressure shall be the greater of the following: System utilizing hydraulic calculations shall allow a 5 PSI loss in addition to all other losses or 10% (including the losses through water-service piping, valves and backflow preventers).

C. REQUIREMENTS OF REGULATORY AGENCIES

1. Requirements of Regulatory Agencies: Perform work in strict compliance with these Specifications and Drawings and all applicable codes, ordinances, standards, and statutes in effect at the building site. All deficiencies as noted by the local jurisdictional authorities shall be corrected. No extra charges will be allowed for these corrections.

D. REFERENCED STANDARDS (MINIMUM CRITERIA)

1. Adhere to the most recent edition of the following publications, together with the latest revisions, supplements and amendments thereto:
    a. Nations fire Protection Association (NFPA) Standards No. 13, 14, 20 and 24 of the latest Edition.
    b. Underwriters Laboratories, Inc. (UL) Fire Protection Equipment List.
    c. The International Building Code, latest edition.
    d. The International Fire Code, latest edition.
2. Listings: All fire protection equipment shall be listed by FM and Underwriters Laboratories, Inc., specifically for use in conjunction with fire protection system.

E. Related Requirements:

1. Mechanical and Electrical Coordination: Section 23 05 01
2. Basic Mechanical Requirements: Section 23 05 20
3. Basic Mechanical Materials and Methods: Section 23 05 03
4. Mechanical Identification: Section 23 05 53
5. Testing, Adjusting and Balancing: Section 23 05 93
6. Demonstrations: Section 23 05 95
7. System Starting: Section 23 05 97
8. Mechanical: Division 23 – All Sections
9. General Requirements: Division 1 – All Sections
10. Automatic Temperature Controls: Section 23 09 00
11. Project Close-Out: Section 23 90 00
12. Plumbing: Division 22 – All Sections

F. DISTRICT REVIEW

1. The review of the documents by the District is intended to assist the Consulting Engineer to comply with the guideline specification. The District's review does not relieve the Consulting Engineer of the responsibility, accountability, completeness and workability of the design.
2. Review Policy: Documents reviewed by the District shall be prepared in the form of redlined plans and annotated specification. These documents shall then be reviewed by the Consulting Engineer.
3. Notification of the non-compliance: When any portion of the guideline specifications will not be met, the Consultant shall notify the School District in writing.

END OF SECTION

SECTION 21 13 00

FIRE PROTECTION

PART – 1 GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Sprinkler Piping and Specialties
      a. Piping
      b. Valving
      c. Specialties

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Referenced Standards: Comply with applicable requirements of the following standards:
      a. Refer Section 21 00 00.

C. WORK INCLUDED
   1. The entire building shall be sprinklered. Sprinkler system shall consist of the following types: Wet and dry pre-action.
      a. The zone which serves the exterior of the building shall be dry pre-action type.
      b. Where approved by the Jurisdictional Fire Authority, heat tracing will be allowed in limited areas; coordinate and consult with district staff prior to specifying.
      c. All other zones such as kitchen area, office area, crawl space and classroom shall be wet type.
      d. Utilize dry type sprinklers in areas within the building subject to freezing temperatures (i.e. freezer/coolers within food service areas) where wet piping systems are otherwise to be installed.

D. SUBMITTALS
   1. Provide Product Data for the following: Piping materials, pip hangers, supports and sprinkler specialty fittings, backflow prevention devices, valves, specialty valves and trim, sprinkler heads, escutcheons and guards, fire department connections, alarm devices with related electrical data.
   2. Fire Protection Contractor shall submit working plans to authorities having jurisdiction for review, approval and acceptance prior to commencing installation. No work shall commerce until approvals are obtained. Working plans shall contain all information relative to the fire sprinkler system.
   3. The Fire Protection Contractor shall furnish the following at completions of his work:
      a. Reproducible tracings of the approved final design layout “as-built”. Refer Section 23 90 00 for additional as- built drawing requirements.
      b. Two (2) copies each of the Contractors Material and Test Certificates for aboveground and underground piping.
      c. Two (2) copies each of “Owner’s Manuals” for fire protection equipment installed, covering operation, inspection, testing and maintenance of the equipment.
      d. Two (2) copies of all hydraulic calculations.

E. RELATED REQUIREMENTS
   1. Basic Requirements: Section 23 05 02
   2. Basic Materials and Methods: Section 23 05 03
   3. Mechanical Identification: Section 23 05 53
   4. Mechanical and Electrical Coordination: Section 23 05 01
   5. Project Close-Out: Section 23 90 00

F. REQUIREMENTS OF REGULATORY AGENCIES
1. Requirements of Regulatory Agencies: Perform work in strict compliance with these Specifications and Drawings and all applicable codes, ordinances, standards, and statutes in effect at the building sire. All deficiencies as noted by the local jurisdictional authorities shall be corrected. No extra charges will be allowed for these corrections.
2. Adhere to the most recent edition of the following publications, together with the latest revisions, supplements and amendments thereto:
    a. National Fire Protection Association (NFPA) Standards No. 13, 14 and 24.
    b. Underwriters Laboratories, Inc (UL) Fire Protection Equipment List
    c. The International Building Code
    d. International Fire Code
3. Where new drain terminations are required, extend new drainage discharge locations to adequate and appropriate points of collection within the building which extend and connect to the sanitary building drainage system.
    a. Where new drain terminations cannot be extended to the sanitary building drainage system, coordinate locations of drain discharge with jurisdictional storm water departments to ensure exterior discharge to grade will be allowed.

G. Listings: All fire sprinkler system equipment shall be listed by Underwriters Laboratories, Inc., specifically for use in conjunction with fire protection system.

H. Certificates: Obtain and pay for all necessary permits before starting work. Obtain certificated, approvals and/or acceptances of all interested parties and authorities having jurisdiction.

I. Certificate of Installation: Submit certificate upon completion of fire sprinkler system work, stating that the work has been completed and tested in accordance with the specified standards, and that there are no defects in the system and that it is operational.

PART 2 – PRODUCTS

A. ACCEPTABLE MANUFACTURES
1. Valves: (Base Bid)
    a. Nibco
    b. Stockham
    c. Watts Industries, Inc., Water Products Dev.
    d. Grinnell Fire Protection
    e. Victaulic Co. of America
    f. Milwaukee
    g. Mueller
2. Fire Department Connections: (Base Bid)
    a. Fire-End and Croker Corp
    b. Potter-Roemer, Fire Protection Div.
    c. Guardian Fire Equipment, Inc.
3. Sprinklers: (Base Bid)
    a. Sprinkler Corp
    b. Star Sprinkler Inc.
    c. Reliable Automatic Sprinkler Co., Inc.
    d. Viking Corp.
4. Alarm Devices
    a. Grinnell Fire Protection
    b. Potter+Electric Signal Company
    c. Viking Corp.

5. Backflow Prevention Devices: (Base Bid)
    a. Ames Fire and Waterworks.
    b. Febco (Division of Watts)
    c. Zurn-Wilkins
6. Combination Inspectors Test and Drain:
    a. Grinnell Fire Protection
    b. Victaulic Co. of America
7. Specialties
    a. Potter Roemer, Fire Protection Div.
    b. Fire-End and Croker Corp.
    c. Guardian Fire Equipment, Inc.
    d. Victaulic Co. of America
    e. Notifier
    f. Potter Electric Signal Co.
    g. Wheelock, Inc.
    h. Farr-Larm
    i. Anvil International, Gruvlok.
8. Compressors
    a. Acceptable Manufactures: (Base Bid)
        1) Nash
        2) Champion
        3) Ingersoll-Rand
    b. Air Compressor Description: Provided compressor unit consisting of air cooled motor compressor, air receiver, aftercooler, spring isolator controls, and all necessary equipment.
9. Dry Pipe Valves
    a. Gem
    b. Viking

B. PIPING
1. Schedule 40, ASTM A 53 B, seamless: Thin wall piping with welded outlets or rolled grooved pipe will be acceptable, provided it is approved by Owner's insurance underwriter, NFPA, and local authority, and is listed for working pressures involved.
    a. Where piping is exposed, fittings shall be weld-end or screwed; not grooved-end or roller grip.

C. FITTINGS
1. Sprinkler System Fittings:
    a. 2" and smaller: 250lb. cast iron, screwed, ASTM A47.2.
    b. 2" and larger: Weld neck or victulic fitting and couplings or approved equal may be used where listed for working pressures involved.

D. GATE VALVES
    a. 2" and smaller: Bronze, 250 PSI with solid bronze wedge, tapered seat, screwed ends and OS&Y rising steam.
    b. 2" and larger: Iron body, bronze mounted, 250 PSI with solid wedge, tapered seat, OS&Y rising steam.

E. CHECK VALVES
1. 2" and Larger: Iron body, bronze mounted, 250 PSI with flanged ends and clapper discs as follows:
    a. Bronze disc for water line entrance.
    b. Composition or rubber faced disc for fire department connection.

F. HANGERS

1. Provide hangers in accordance with section 23 05 03. Hangers shall be of type specifically approved for use in fire protection systems. C-type clamps shall not be used without retaining straps.

G. FIRE DEPARTMENT CONNECTION
1. Fire department connection shall be of type, size, configuration, finish as scheduled, with hose threads to match that of local fire department. Furnish complete with check valves, caps, chains and appropriately branded plate.
    a. Include Knox style locking cap where required by jurisdictional fire authority.

H. SPRINKLERS
1. Standard automatic sprinklers of proper temperature rating, UL approved as follows:
    a. Upright or pendant, factory brass finish in all areas where sprinkler piping is exposed (except where future ceilings are to be installed)..
    b. Recessed pendant, satin chrome finish, with matching escutcheons in all rooms with suspended ceilings and where future ceilings are to be installed.
    c. Dry Pendant, satin chrome finish, with matching escutcheons in all rooms with ceilings and exposed to freezing conditions.
    d. Horizontal sidewall, satin chrome finish with matching escutcheons.
    e. Extended coverage horizontal sidewall satin chrome finish with matching escutcheons.
    f. Dry horizontal sidewall, factory bronze finish with wall escutcheon.
    g. Provide wire guards on sprinkler heads in Mechanical Room.

I. ELECTRIC ALARMS
1. Combination intermittent horn and flashing light alarm device, UL listed for outdoor use, mounted on exterior wall near fire department connection.
    a. Coordinate specifications for horn and strobe with fire alarm system designer.
2. Waterflow indicators in automatic sprinkler riser, Potter Roemer 6200 Series or approved equal.
3. Tamper Switches:
    a. Potter-Roemer Fig. 6220 or approved equal for OS&Y gate valves.
    b. Potter-Roemer Fig. 6221 or approved equal for rising stem globe valves.

J. BACKFLOW PREVENTION DEVICES
1. Preferred, Double Check Valve Assembly: UL listed of type, size, configuration and finish as scheduled with resilient seated inlet valves and test valves.
2. Where specifically required by the Jurisdictional Water Department, Reduced Pressure Backflow Preventer: UL listed of type, size, configuration and finish as scheduled with resilient seated OS&Y gate valves.
3. Backlow prevention devices shall be approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California.
4. End Connections: Flanged, grooved or Threaded.
5. Pattern: As required by special conditions; ensure valving is mounted no higher than 4’-0” above the surrounding finished floor.
    a. Where devices are mounted higher than 4’-0” coordinate with district staff for serviceability requirements and service platform design.

K. SPECIALTIES
1. General: UL listed with end connections matching piping and equipment connected to.

2. Escutcheons: Provide premanufactured trim rings at all pipe penetrations through walls, floors and ceilings exposed to view in finished spaces.
3. Waterflow indicators (flow switches): Vane type, 250 PSI rated, shaded pole double throw type 120V/1 PH/60HZ complete with adjustable retard element and tamper proof cover.
4. Tamper switches: Shaded pole singe throw type, 120 V/1 PH/60HZ with tamper proof cover. Shall signal alarm when valve is not in full open position.
5. Alarm horn and light: Weatherproof construction, 115V/1 PH minimum 95 DBA at 10 foot: Position directly above fire department connection to signal water flow in the sprinkler system.

L. DRY PRE-ACTION

1. System Components
    a. Deluge Valve.
    b. Release Trim: Pneumatic actuator (diaphragm bypass), strainer, shuttle valve, release system air pressure gauge and valve, air supervisory pressure switch (release system).
    c. Waterflow Alarm Trim: Water motor alarm, alarm pressure switch.
    d. Riser valves: Water supply control valve, rubber seat check valve, system main drain valve.
    e. System Air Supply Trim: System pressure gauge and valve, soft seat check valve, air supervisory pressure, switch (sprinkler system).
    f. Deluge Valve Standard Trim: Test drain valve, auxiliary drain valve, drain cup, drip check, alarm test shut off valve, pressure operated relief valve, priming valve, emergency release, priming pressure gauge and valve, water supply pressure gauge and valve.
    g. Air Supply Trim: Air maintenance device, relief valve, soft seat check valve, dehydrator, air supervisory pressure switch (air compressor), air compressor.

END OF SECTION

SECTION 22 00 00

INTRODUCTION

PART 1- GENERAL

A. OVERVIEW
   1. This guideline specification is for the Consulting Engineers and outlines minimum requirements for the District. The Consulting Engineer should apply these guidelines consistent with the budget constraints. The Consulting Engineer must select among the mechanical systems, size and specific equipment and materials within the budget and design limits. The guidelines are based upon considerable experience with the purpose of providing the best values for the available money.
   2. The applicable provisions elsewhere in Divisions 21, 22, and 23 shall apply.
   3. Related Requirements:
      a. Basic Mechanical Regulations: Section 23 00 03
      b. Basic Mechanical Materials and Methods: Section 23 00 04
      c. Mechanical Noise and Vibration: Section 23 05 48
      d. Mechanical Identification: Section 23 05 53
      e. Mechanical Insulation: Section 23 07 00
      f. Demonstrations: Section 23 05 95
      g. System Starting: Section 23 05 97
      h. Condensate Piping: Section 23 21 15
      i. Project Close-Out: Section 23 90 00

B. DESIGN
   1. The Consulting Engineer is required to provide a complete and workable design. The Consulting Engineer is responsible and accountable for his/her work. If in the opinion of the Consulting Engineer any portion of these guideline specifications or system performance function will not be complied with, the Engineer will notify the District in writing.

C. DISTRICT REVIEW
   1. The review of the documents by the District is intended to assist the Consulting Engineer to comply with the guideline specification. The District's review does not relieve the Consulting Engineer of the responsibility, accountability, completeness, and workability of the design.
   2. Review Policy: Documents reviewed by the District shall be prepared in the form of redlined plans and annotated specifications. These documents shall then be reviewed by the Consulting Engineer.
   3. Notification of non-compliance: When any portion of the guideline specifications will not be met, the Consultant shall notify the School District in writing.

END OF SECTION

SECTION 22 01 00

PLUMBING PIPNG

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Domestic Hot and Cold Water Piping
   2. Sanitary Drainage and Vent Piping
   3. Grease Drainage Piping
   4. Roof Drainage Piping and Drains
   5. Floor Drainage Piping and Drains
   6. Valves and Specialties
   7. Cleanouts
   8. Anti-Siphon Equipment
   9. Rough-In for Equipment and Fixtures
   10. Water Meter and Meter Valves, Readout Station and Accessories
   11. Acetylene and Oxygen Piping
   12. Acid Waster and Vent piping
   13. Welding Equipment
B. REFERENCED STANDARDS- MINIMUM CRITERIA
   1. AWWA Standard C651-86
   2. ANSI
   3. ASTM
   4. International Plumbing Code
C. SUBMITTALS
   1. Shop Drawings and Product Data:
      a. Floor, Roof and Area Drains
      b. Cleanouts
      c. Storm Leader Expansion Joints
      d. Overflow Roof Drains
      e. Downspout Nozzles
      f. Wall Hydrants and Hose Bibbs
      g. Shock Absorbers
      h. Acid Neutralization Tanks
      i. Solids Interceptors and Plaster Traps
      j. Grease Interceptor
      k. Welding equipment
      l. Piping, Fittings and Couplings
   2. Operating and Maintenance Data:
      a. Shock Absorbers
      b. Acid Neutralization Tanks
      c. Solid Interceptors and Plaster Traps
D. RESTRICTIONS/CRITICAL CRITERIA
   1. Water Distribution System
      a. Design Criteria:

1) Route piping as direct as possible to required connections, and call for piping to slope to drain valves at low points for complete system drain down.
2) Specify drain valves at accessible points within the system.
3) Coordinate routing with other trades and with building construction.
4) Specify connections to all equipment and fixtures indicated on the drawings or specified herein.
5) Provide ball valves for branch lines off main, sub-main take-offs and main take-offs.
6) Provide building shut-off and separate hose end drain valves with vacuum breaker at main service entry.

2. Sanitary and Storm Sewer System
   a. Installation:
      1) Run soil and waste piping at a grade of not less than 2.08%. Run storm piping at a grade of not less than 1.04%.
      2) Do not install vents within 2’ of roof edge, parapet or wall line of an “on-the-roof” structure.
      3) Do not install vents within 15’ of outside air intakes. Extend vents up to 2’-0” above outside air intake elevations where 15 foot separation cannot be attained.
      4) Extend all vent terminations a minimum of 2’-0” above surrounding roof elevations.
      5) No combination waste and vent, horizontal or vertical wet venting systems shall be installed unless specifically reviewed and approved by the District Staff.
3. Grease Drainage System
   a. Installation:
      1) Run grease drainage piping at a grade of not less than 2.08%.
      2) Combination waste and vent systems are not allowed for grease drainage systems.
4. Floor Drains and Floor Sinks
   a. Specify floor drains and floor sinks with deep seal P-traps and vent as required.
   b. Specify stainless steel floor sinks at commercial dish machines and at other locations within the food service area where elevated discharge water temperatures are anticipated.
   c. Specify stainless steel receptors at locations where indirect waste may be corrosive (condensing gas fired appliances).
   d. Specify floor drains and sinks of corrosive resistant materials where they are to be installed in areas subject to chemical disposal.
5. Cleaning
   a. Domestic Water Systems:
      1) Clean piping of dirt, debris, slag, solder, burrs and restrictions by flushing with water or acid to remove or dissolve foreign particles that may be within the piping system.

2) Sanitize potable water piping in accordance with AWWA Standard, C651, "Disinfecting Water Mains", latest edition and all local jurisdictional requirements.

PART 2- PRODUCTS

A. PIPE AND PIPE FITTINGS
   1. Domestic Hot and Cold Water- Inside Building:
      a. Above grade: Type L copper with wrought copper fittings and no-lead solder joints.
         1) Hot Water Circulation Piping:
            a) Utilize long radius elbows on all hot water circulation systems utilizing copper fittings.
            b) At consultants option, the use of AquaTherm Green Piping systems will be allowed.
      b. Below grade:
         1) 3" and smaller: Type K hard drawn copper with wrought copper fittings and silver brazed joints.
            a) Specify annealed copper for small individual equipment connections needing to extend below slab on grade; limit pipe length, joints and fittings below slab in these locations will not be allowed.
         2) Larger than 3":
            a) Class 22 cement lined cast iron with cast iron fittings and hub and spigot joints with mechanical clamp.
            b) AWWA C900 PVC with cast iron OD dimensions, ASTM F477 gaskets and ASTM D3139 joints; coordinate pressure classification with jurisdictional water department
   2. Sanitary Drainage- Inside Building:
      a. Above grade:
      4" and smaller: Cast iron no-hub pipe and fittings with elastomeric couplings and stainless steel shield and clamp assembly.
         1) Larger than 4": Cast iron no-hub pipe and fittings with elastomeric couplings and extra wide, heavy duty stainless steel shield with heavy duty clamps.
      b. Below grade:
         1) Service weight cast iron bell and spigot pipe and fittings with elastomeric joints.
         2) Schedule 40 solid core PVC with PVC fittings and solvent cement joints.
         3) Where discharge water temps will exceed the temperature rating of PVC, utilize cast iron specified above.
   3. Grease Drainage Piping:
      a. Above Grade:
         1) Epoxy coated cast iron no-hub pipe and fittings with elastomeric couplings and heavy duty stainless steel shield with heavy duty clamps.
         2) Schedule 40 solid core PVC with PVC fittings and solvent cement joints where located within crawlspace and where drainage discharge temperatures will not exceed 120 degrees F.

b. Below grade:
    1) Epoxy coated service weight cast iron bell and spigot pipe and fittings with elastomeric joints.
    2) Schedule 40 solid core PVC with PVC fittings and solvent cement joints.
    3) Where discharge water temps will exceed the temperature rating of PVC, utilize cast iron specified above.

4. Vent Piping:
    a. Above grade: Cast iron no-hub pipe and fittings with elastomeric couplings and stainless steel shield and clamp assembly.
    b. Below grade:
        1) Service weight cast iron bell and spigot pipe and fittings with elastomeric joints.
        2) Schedule 40 solid core PVC with PVC fittings and solvent cement joints.
5. Roof Drainage- Inside Building:
    a. Above grade: Cast iron no-hub pipe and fittings with elastomeric couplings and extra wide, heavy duty stainless steel shield with heavy duty clamps.
        1) Coordinate with district staff for specifying Black Swan coupling sealant at all no-hub couplings installed on storm water drainage systems.
    b. Below grade:
        1) Service weight cast iron bell and spigot pipe and fittings with elastomeric joints.
        2) Schedule 40 solid core PVC with PVC fittings and solvent cement joints.
    c.
6. Equipment Drains and Overflows: Type L or M hard drawn copper with wrought copper, bronze or cast brass fittings and no lead solder joints.
    a. Where exposed in finished spaces, piping shall be polished chrome plated or painted with Chrome Paint.
7. Acetylene Piping: Type L hard copper with wrought copper seat fittings made up with no lead solder.
8. Oxygen Piping: Type L hard copper with wrought copper seat fittings and silver brazed joints.
9. Acid Waste and Vent:
    a. Schedule 40 flame retardant polypropylene with compatible fittings with fused joints in concealed locations and mechanical joints where piping is accessible.
    b. PVDF with drainage pattern fittings and fusion welded joints.
    c. CPVC with drainage pattern fittings and solvent cement welded joints.
        1) Obtain approval from jurisdictional entities prior to specifying.
    d. All piping systems specified for installation within air distribution plenums shall be tested to ASTM E-84 for flame spread and smoke development.

B. UNIONS AND COUPLINGS
1. 2" and Under:
    a. For threaded ferrous piping: ANSI/ASTM 150 PSI malleable iron ground join unions.
    b. For copper piping: ANSI BIG-22 WROT Copper.
2. 2 1/2" and Over:
    a. For ferrous piping: ASTM 181, Grade l, 150 PSI forged steel slip-on flanges.
    b. For copper piping: 150 PSU bronze flanges.

c. Gaskets: 1/16” thick preformed synthetic red rubber for cold water systems, black rubber for hot water system.

3. Dielectric Unions: Use dielectric unions at connections to water heater and storage tanks, as well as between dissimilar metals, i.e. steel valves and copper pipe.

C. PLUMBING SPECIALTIES

1. Shock Absorbers (Water Hammer Arrestors):
   a. General: Provide Plumbing and Drainage Institute (PDI) approved types and sizes as scheduled or required.
   b. Acceptable Manufactures:
      1) Jay R. Smith
      2) Josam
      3) Wade
      4) Wilkins
      5) Zurn
      6) Sioux Chief
      7) Precision Plumbing Products.
2. Hose Bibbs:
   a. General: Provide hose thread outlet with vacuum breaker in each mechanical room having a floor drain and elsewhere as indicated with finish as scheduled.
   b. Acceptable Manufactures:
      1) Exposed Locations:
         a) Chicago
         b) Wade
         c) Woodford
         d) Zurn
      2) Recessed Locations:
         a) Woodford
         b) Wade
         c) Josam
         d) Zurn
3. Wall Hydrants:
   a. General: Provide wall hydrants, non-freeze as schedules. Hydrants to be self-draining type with integral vacuum breaker and satin nickel face.
   b. Acceptable Manufactures.
      1) Woodford
      2) Wade
      3) Josam
      4) Zurn

D. ROOF DRAINS AND ACCESSORIES

1. Acceptable Manufacturers:
   a. Jay R. Smith
   b. Josam

c. Wade
d. Zurn

2. Flashing: Provide flashing pans for each drain or pairs of drains where roof drains and overflow drains are adjacent.

E. FLOOR DRAINS, TRENCH DRAINS, AREA DRAINS AND FLOOR SINKS
1. Acceptable Manufacturers:
a. Floor Drains, Area Drains and Floor Sinks:
1) Jay R. Smith
2) Josam
3) Wade
4) Zurn
b. Acid resistant Floor Drains:
1) Enfield
2) Orion
3) Zurn
c. Trench Drains:
1) Aco
2) Polydrain
3) J.R. Smith
4) Zurn
2. Flashing: Provide 24” x 24” flashing pans for each drain located above slab on grade areas including areas over accessible crawlspaces.
3. Specify floor sinks with secured, non-tilting style grates in food service areas.
4. Specify stainless steel floor sinks at the kitchen dish machine and at 3-compartment sinks.
5. Trench drain grates shall be selected based on the specific application and location, coordinate selections with district staff during the design phase.

F. CLEANOUTS AND CLEANOUT COVERS
1. Acceptable Manufacturers:
a. Jay R. Smith
b. Josam
c. Wade
d. Zurn
2. Flashing: Provide 24” x 24” flashing pan with clamp device for each floor cleanout located above slab on grade areas including areas over accessible crawl spaces.

G. WATER METER
1. Comply with the Local Water Department Standards. Provide valves, sleeves, couplings, by-pass, remote read-out station, accessories as required and appropriate. Coordinate with Civil Engineer as to whether interior or exterior location of water meter(s).

H. ACID NEUTRALIZATION TANKS
1. General: Provide high density polyethylene tank of seamless construction with accessible lid and mechanical joint connections.
2. Acceptable Manufactures:
a) Enfield
b) Orion

c) Zurn

3. Specify for contractor to furnish and fill the tank prior to operation with approved neutralization agent such as limestone or marble chips, one to three inches in size, to a level just below tank outlet. Water shall be added to the tank after placement of neutralization agent.

I. GREASE INTERCEPTOR

1. General: Reinforced precast concrete designed for H-2O wheel loads of 16,000 lbs. or greater. Provide complete with internal baffle, inlet, outlet, baffle fitting and vent openings. Separate reinforced precast concrete lid with lift rings and 24" round access openings. Provide precast concrete riser rings and heavy duty gas-tight manhole frames with solid lid. Where allowable, specify a dual manhole lid with the inner lid gasketed and secured to limit vapors from escaping through the single manhole lid.
2. Acceptable Manufacturers:

   a. Copeland
   b. Faust
   c. Carder

J. SOLIDS INTERCEPTORS

1. General: Provide on-floor type with top access, internal deep seal trap and removable sediment bucket.
2. Acceptable Manufacturers:
   a. Jay R. Smith
   b. Josam
   c. Wade
   d. Zurn

END OF SECTION

SECTION 22 11 15

CONDENSATE PIPING

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
    1. Condensate Piping
B. RESTRICTIONS/CRITICAL CRITERAI
    1. Route piping in orderly fashion to indirect waste receptors connecting to the building sanitary drainage system or to other approved points of discharge...
    2.
    3. Rough-in connection to condensing equipment. Coordinate with condensing equipment specifying engineer for locations and condensate flow rates anticipated.
    4. Provide condensate drain lines for each rooftop unit specified with cooling capacity. Trap shall be full size of unit opening and provide minimum 4” water seal. Discharge condensate to roof with splash block, coordinate splash block locations with roofing manufacturer, protect existing roofing systems from damage.
    5. Provide condensate drain lines for OA intake louvers and intake hoods. Refer Section 23 31 13.

PART 2- PRODUCTS

A. PIPING
    1. Above grade, Cooling Coil Condensate: DWV copper with drainage pattern fittings and no-lead soldered joints. .
    2. Above Grade (Combustion Condensate): Refer to Section 22 01 00, utilize approved piping materials for corrosive drainage service with drainage pattern fitings.
        a. Specify approved condensate neutralization kits and detail connection requirements in accordance with manufacturer’s installation instructions.
        b. Extend and discharge to approved indirect waste receptor.

END OF SECTION

SECTION 22 11 19
PLUMBING VALVES AND SPECIALTIES

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Valves
   2. Specialties
   3. In-Line Circulation Pumps
B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Comply with applicable requirements of the following standards:
      a. National Certified Pipe Welding Bureau (NCPWB)
      b. ASME Boiler Pressure Code
      c. American Society of Sanitation Engineers (ASSE)
      d. American Water Works Association (AWWA)
      e. ANSI B31 Code for Pressure Piping
      f. Underwriters' Laboratories Inc. (UL)
      g. International Plumbing Code
      h. National Fire Protection Association (NFPA)
      i. National Electrical Manufacturer's Association (NEMA)
      j. National Electrical Code (NEC)
      k. American Welding Society (AWS)
      l. American National Standards Institute (ANSI)
      m. National Sanitation Foundation (NSF)
C. SUBMITTALS
   1. Product Data:
      a. Valves
      b. Specialties
      c. In-Line Circulation Pumps
   2. Operating and Maintenance Data:
      a. Valves
      b. Specialties
      c. In-Line Circulation Pumps
D. RESTRICTIONS/CRITICAL CRITERIA
   1. Valves
      a. Install ball valves for shut-off and isolating service, to isolate equipment, parts of system or vertical risers on piping smaller than 3-inch. Utilize butterfly style valves for pipe sizes 3-inch and larger.
      b. Gate valves will only be allowed at the main water service entry into the building where the service size is 3-inch or larger. Flanged ends with resilient seated wedge, ductile iron with stainless steel trim.
      c. Install plug valves or angle valves for throttling service and control device or meter bypass.

d. Provide ball type drain valves at main shut-off valves, low points of piping and apparatus.
e. Specify all valves and specialties sized 2-inch and smaller, coming in contact with potable water to be of low or no lead content in accordance with ANSI-NSF-61.

PART 2- PRODUCTS

A. VALVES
1. Acceptable Manufacturers:
a. Ball Valves:
1) Conbraco-Apollo
2) Grinnell-Tyco
3) Milwaukee
4) Nibco
b. Butterfly Valves:
1) Conbraco-Apollo
2) Grinnell-Tyco
3) Keystone
4) Milwaukee
5) Nibco
c. Gate Valves:
1) Clow
2) Nibco
3) Mueller
4) Milwaukee
d. Plug Valves:
1) Clow
2) DeZurick
3) Milliken
4) Nordstrom
e. Globe Valves:
1) Conbraco-Apollo
2) Grinnell-Tyco
3) Milwaukee
4) Nibco
5) Hammond
f. Angle Valves:
1) McGuire
2) Grinnell-Tyco
3) Milwaukee
4) Nibco
5) Hammond
g. Check Valves:
1) Conbraco-Apollo
2) Grinnell-Tyco

3) Milwaukee
4) Nibco
5) Hammond

h. Balancing Valves (Calibrated):
1) Flow Design-Flowset
~~2) Griswold Controls~~
3) ITT Bell & Gossett
4) Taco

2. General: All valves of a given type shall be of one (1) manufacturer and shall be listed with the Manufacturers' Standardization Society of the Valve and Fittings Industry.
3. Valve Connections:
   a. Thread pipe sizes 2" and smaller.
   b. Flange pipe sizes 2 1/2" and larger.
   c. Solder or screw to solder adapters for copper tubing.
   d. Provide butterfly valve with tapped lug body 200 PSI minimum working pressure, when used for isolating service. Valves shall be rated for bi-directional dead head end service to full working pressure of valve with downstream flange removed.
   e. Ball valves, gate valves, globe valves and plug valves on domestic water service shall meet the requirements of NSF 61.
4. Gate Valves: 4" and larger for main domestic water entry only: Iron body, bronze or stainless steel trim, rising stem, OS&Y bolted solid wedge with resilient seat, bolted bonnet, flanged ends, 125 SWP, 200 WOG.
5. Globe or Angle Valves:
   a. 2" and smaller: Bronze, union bonnet, Teflon disc, 150 SWP, 300 WOG, soldered or screwed ends.
   b. 3" and larger: Cast iron body, bronze trim, rising stem OS&Y, renewable Teflon disc, bolted bonnet, 125 SWP, 200 WOG, flanged ends.
6. Ball Valves: Bronze or forged brass, swing-away design, full port, chrome plated bronze or stainless steel ball with Teflon seats, 125 SWP, 400 WOG, screwed or soldered ends. Ball valves on domestic water service shall meet the requirements of NSF 61.
7. Plug Valves:
   a. 2" and smaller: Bronze, swing disc, solder or screwed ends.
   b. 2 1/2" and larger: Iron body, bronze trim, rising stem, OS&Y, renewable composition disc, flanged ends.
8. Drain Valves: Bronze, compression stop or ball style with nipple and cap or hose thread.
9. Balancing Valves: Bronze body/brass ball construction with glass and carbon filled TFE seat rings, differential pressure readout ports across valve seat area fitted with internal EPT inserts and check valves, ¼" NPT tapped drain/purge port, memory stop, calibrated nameplate and solder connections. Valve shall be designed for positive shut-off. Design pressure 200psig @ 250°F.
10. Check Valves:
    a. Swing check valves:
       1) 2" and smaller: Bronze, horizontal swing disc, renewable Teflon seat, solder or screwed ends, 150 lbs. SWP, 300 WOG.

2) 3” and larger: Cast iron body, bronze trim, horizontal swing disc, renewable bronze disc and seat, flanged ends, 125 lb. SWP, 200 WOG, bolted bonnet.

b. Spring loaded silent check valves:

1) 2” and Smaller: Lead free bronze body, stainless steel trim, in-line lft type with resilient disc, 250 CWP.

2) 3” and Larger: Cast iron body, bronze trim, spring loaded, renewable bronze seat and disc, wafer type, stainless steel springs, 250 lb. WOG.

11. Valve Operators:

a. Provide suitable handwheels for gate, globe or angle and drain valves, lever handles for ball valves.

b. Provide one (1) plug cock wrench for every ten (10) plug cock sizes 2” and smaller, minimum of one (1). Provide each plug cock size 3” and larger with a wrench with set screw.

c. Provide chain operators for valves 4” and larger located more than 7 feet from floor in equipment rooms. Extend chains to 5 feet from floor and hook to clips arranged to clear aisles.

12. Pressure Ratings: Unless otherwise indicated, use valves suitable for minimum 125 PSIG saturated steam pressure and 200 PSIG non-shock cold water, oil or gas.

B. SPECIALTIES

1. Reducing Valves:

a. Acceptable Manufacturers:

1) Zurn

2) Wilkins

3) Watts

4) Cash/Acme

2. Pressure and temperature Relief Valves:

a. Acceptable Manufacturers:

1) Conbraco-Apollo

2) Watts

3) Cash/Acme

3. Reduced Pressure Backflow Preventers:

a. Acceptable Manufacturers:

1) Ames Fire and Waterworks.

2) Zurn

3) Watts

4) Febco

5) Wilkins

4. Thermostatic Mixing Valves:

a. Acceptable Manufacturers:

1) Bradley

2) Caleffi

3) Watts

4) Leonard

C. PUMPS (DOMESTIC HW CIRC PUMP)
   1. Acceptable Manufacturer:
      a. Bell and Gossett
      b. Crundfos
      c. Paco
      d. Taco
   2. Description: In-line sealless cartridge type circulation pump specifically designed for domestic potable hot water circulation applications, flanged or threaded inlet and outlet connections.
   3. Close coupled pumps are preferred over split coupled circulators, coordinate with school district staff prior to specifying split coupled domestic circulation pumps.
   4. The use of self-balancing or variable speed pumps shall be investigated and reviewed with district staff during the design.
   5. Controls for the pump shall enable pump operation based on building occupancy; on-off control shall be through a temperature sensing element which will shut the pump off once the system return water temperature has reached a determined set point.

End of Section

SECTION 22 11 23

NATURAL GAS SYSTEMS

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Natural Gas Systems:
      a. Natural Gas Piping
      b. Valves and Specialties
B. REFEREMCED STANDARDS (MINIMUM CRITERIA)
   1. General: Installation shall be in accordance with NFPA 54, International Fuel Gas Code and local doe enforcement agencies.
C. SUBMITTALS
   1. Product Data:
      a. Pipe, Pipe Fittings, Gas Cocks and valves
      b. Pressure Regulating Valves
      c. Gas Cabinets
   2. Operating and Maintenance Date:
      a. Gas Cocks and Valves
      b. Pressure Regulating Valves
D. RESTRICTIONS/CRITICAL CRITERIA
   1. Locate gas entry into building as close to exterior building wall as possible. Provide two bollards where pipe enters the building to protect piping from damage.

PART 2- PRODUCTS

A. NATURAL GAS PIPING
   1. Above Grade
      a. 2” and smaller- exposed location: Schedule 40 black steel with 150 lb. malleable iron fittings and threaded joints or Corrugated Stainless Steel Pipe (Trac-Pipe only) with Auto Flare fittings.
      b. 2” and smaller- inaccessible location: Schedule 40 black steel with standard weight socket weld fittings and welded joints.
      c. Over 2”- exposed location: Schedule 40 black steel with seamless steel butt weld fittings and welded joints.
      d. Over 2”- inaccessible locations: Schedule 40 black steel with standard weight socket weld fittings same thickness as pipe and welded joints.
      e. Aluminum tubing for gas piping at burners and relief vent shall not exceed 24 inches in length. Remaining piping to be steel.
   2. Below Grade: Approved polyethylene (PE) plastic gas pressure pipe, tubing and fittings, and socket heat fusion joints or factory wrapped Schedule 40 black steel with welded fittings and joints.

B. VALVES AND SPECIALTIES
   1. Valves General:
      a. ¾" and smaller: Screwed, Nordstrom 142 (200 Lb.)
      b. 1" and larger: Lubricated plug valve, flanged, 150 lb. WSP, 200 lb. WOG, all iron (semi-steel), wrench operated, Homestead figure 602.
      c. 8" and larger: Lubricated plug valve, flanged, 150 lb. WSP, 200 lb. WOG, all iron (semi-steel) , wrench operated, Homestead figure 602-A.
   2. Pressure Regulating Valves: Provide gas fired equipment with gas pressure regulators of size and capacity required to reduce gas pressure to proper operating pressure.
   3. Gas Solenoid Valve: Aluminum valve body with nylon disk and stainless steel springs. Ambient temperature range of 32°F to 77°F. Explosion proof solenoid with Class H high temperature coil; ASCO Redhat II
   4. Science Gas Cabinet:
      a. Provide independent manual and automatic natural gas shut-off capabilities for each laboratory or prep room that requires natural gas service as part of the curriculum. Both valves shall be located within a recessed metal cabinet, positioned within the space served, immediately adjacent to the egress door and shall be labeled "Gas Shutoff".
      b. Provide key actuated control switches with integral pilot lights and emergency push-button off capabilities for control of gas solenoid valves. Control switches shall be located within the room or area served and shall be positioned immediately adjacent to the egress door and shall be labeled "Emergency Gas Shutoff Control".
         a. Interface with fire alarm system and laboratory power controls.
   5. Gas Pipe Conduit:
      a. Underground Exterior: Schedule 40 PVC socket type where crossing below sidewalks or other paved site surfaces to limit future disruption to pavement; extend conduit a minimum of 3'-0" beyond surface pavement being traversed.
      b. Below floor slab:
         a. Galvanized steel, extended a minimum of two (2") inches above floor slab at both ends with terminations located in an accessible location within the building.
         b. Piping extending through slabs to work benches or other equipment shall be provided with floor utility channels or trenches complete with non-slip covers which will allow access to the piping without damaging interior building finishes.
   6. Science Lab Gas Outlets: Deck or backsplash mounted, single or double turret with quarter turn ball style, full flow valves, and serrated nozzle outlet with indexed lever handle. Outlet complete with integral check valve.
      a. Approved Manufacturers:
         i. Chicago Faucet Company
         ii. T&S Brass
         iii. Watersaver Faucet.
   7. Quick Disconnect Couplings
      a. Approved Manufacturers:
         1) Dormont
         2) Approved Equal

b. Description: Approved, listed quick disconnect device with nipple and coupling, positive shut-off.

END OF SECTION

SECTION 22 15 13

COMPRESSED AIR SYSTEMS

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
    1. Compressed Air Systems:
        a. Compressed Air Piping
        b. Valves and Specialties
B. REFERENCED STANDARDS (MINIMUM CRITERIA)
    1. ASME
C. SUBMITTALS
    1. Product Data:
        a. Pipe, Fittings, Valves and Specialties
        b. Air Compressor
    2. Operating and Maintenance Data:
        a. Valves and Specialties
        b. Air Compressor
D. RESTRICTIONS/CRITICAL CRITERIA
    1. Piping:
        a. Provide valved drip connections at low point of piping system.
        b. Install take-offs to outlets from top of main with shut-off valve after take-off.
        c. Specify flexible connections at all inlet and outlet piping connections to compressors and receivers.
    2. Locate compressors in areas where noise generation will not be of concern (service areas). Where compressors must be located within or adjacent to educational spaces, coordinate with district staff to ensure acoustical treatment requirements are addressed during the design phase, an acoustical engineer may be required.
    3. Ensure that vibrational forces are addressed during the design, specifically when compressed air equipment is located on structural flooring systems.
    4. Coordinate air quality with district staff and if possible, end users; specify compressors capable of delivering air at the pressures and volumes required for the service intended with air dryers where dry air is required.
    5. Specify inlet connections with filters and silencers where generated noise is of concern.

PART 2- PRODUCTS

A. AIR COMPRESSOR
    1. Acceptable Manufacturers:
        a. Quincy
        b. Ingersol Rand
    2. Accessories: Provide filters, regulators, air dryer, safety valve, automatic tank drain, belt guard and intake filter silencer as detailed on Drawings.

3. Select the type and style of compressor based on the duty and application intended. Reciprocating compressors are most frequently used, sliding vane or rotary screw machines may be appropriate based on pressures and volumes required.

B. COMPRESSED AIR PIPING
   1. Type L hard copper with wrought copper or cast brass fittings.
   2. No-lead solder joints for systems operating below 100 psig.
   3. Brazed or press-fit joints shall be specified for systems operating over 100 psig.
   4. Schedule 40 black steel with 150 lb malleable iron fittings and threaded joints will be acceptable where the application for clean dry air is not applicable.
   5. Where larger pipe sizes are anticipated, investigate stainless steel tubing or the use of flared fittings and joints in copper tubing applications.

C. SPECIALTIES
   1. Quick Disconnect Coupling- Acceptable Manufacturers:
      a. Quincy
      b. Binks
      c. Approved Equal

END OF SECTION

SECTION 22 40 00

PLUMBING EQUIPMENT

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Domestic water heating equipment and accessories.
B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ASHRAE/IESNA 90.1- Compliance: Applicable requirements in ASHRAE/IESNA 90.1-Latest Edition.
   2. ASME Compliance:
      a. Where ASME-code construction is required, specify commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   3. Where ASME-code construction is required, specify commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV. For gas fired appliances, specify compliance with ANSI/CSA.
   4. For electrical appliances, specify compliance with NFPA 70.
   5. For indirect fired appliances such as side-stream water heaters or indirect water heating equipment, specify compliance with ASME.
C. SUBMITTALS
   1. Product Data:
      a. Domestic Water Heating Equipment.
      b. Storage Tanks.
      c. Accessories
   2. Operating and Maintenance Data:
      i. Domestic Water Heating equipment
D. RESTRICTIONS/CRITICAL CRITERIA
   1. Water Heater: Provide minimum five (5) year manufacturer's warranty in accordance with this section. Coordinate warranty period with School District Staff during design process.
   2. Water Storage Tank: Provide minimum five (5) year manufacturer's warranty in accordance with this section. Coordinate warranty period with School District Staff during design process.
   3. Provide System Startup per Section 23 05 97.
   4. Provide Demonstrations per Section 23 05 95.

PART 2- PRODUCTS

A. General: Provide all water heating systems with the following accessories unless otherwise required by the equipment manufacturer:
   1. Specify inlet and outlet isolation valves to each water heater and independent storage tank. Confirm ASME ratings on separate storage tanks.
   2. Specify thermometers on outlets from each water heating system and storage tank. Coordinate placement for ease of readability.

3. Specify combination pressure temperature relief valve conforming to ANSI Z21.22 at each storage heater or unfired storage tank.
4. Specify vacuum relief valve on inlet piping to each bottom fed water heating system or storage tank. Vacuum relief valve shall conform to ANSI Z21.22.
5. Confirm manufacturer recommended service clearances are maintained to allow for proper maintenance, servicing and removal of water heating systems and components.
6. Specify labeling and identification in accordance with other sections of this guideline. Coordinate with district staff for specific numbering requirements at facilities with multiple water heating systems.
7. Coordinate flue and combustion air to the exterior with other building systems.
8. Where natural gas fired appliances are specified, call for gas shut-off, dirt leg and union at appliance connection.
9. Where condensing appliances are specified, call for condensate neutralization kits and detail required installation.
10. Coordinate with district staff for specific building automation system interface.
11. Coordinate housekeeping pad requirements. Provide a minimum 4" high pad.

B. GAS FIRED DOMESTIC STORAGE WATER HEATER
1. General: Specify natural gas fired domestic water storage heater with integral storage tank complete as called for in equipment list on drawings.
2. Water heaters shall be tested in accordance with ANSI Z21.10.1 and Z21.10.3.
3. Water heaters shall meet ASME Boiler and Pressure Vessel Requirements.
4. Provide pressure relief and temperature relief valve, or combination pressure/temperature relief valve complying with ANSI Z21.22.
5. Acceptable Manufacturers:
   a. Bock Water Heaters
   b. HTP
   c. Lochinvar, LLC
   d. Rheem

C. HIGH-EFFICIENCY, GAS WATER HEATERS:
1. Specify Compliance with ANSI Z21.10.3/CSA 4.3.
2. Manufacturer's proprietary design to provide at least 88 percent combustion efficiency at optimum operating conditions.
3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
4. Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets; anode-less linings preferred.
5. Acceptable Manufacturers:
   a. Aerco
   b. Bock Water Heaters
   c. Lochinvar
   d. Rheem

D. FINNED-TUBE, GAS WATER HEATERS:
1. Specify Compliance with ANSI Z21.13 for hot-water boilers.
2. Packaged unit with boiler, storage tank, pump, piping, and controls.

3. Horizontal, straight, or coiled finned-copper tube heat exchanger with bronze headers and burner for natural gas fuel.
4. Insulation: Comply with ASHRAE/IESNA 90.1.
5. Steel jacket with enameled finish.
6. Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.
7. Automatic, high-temperature-limit cutoff device or system.
8. Intermittent electronic ignition complying with ANSI Z21.20.
9. Hot-Water Storage Tank:
    a. ASME Boiler and Pressure Vessel Code: Section VIII.
    b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings; anode-less materials preferred.
    c. Insulation: Comply with ASHRAE/IESNA 90.1.
    d. Jacket: Steel with enameled finish.
    e. Anode Rods: Factory installed, magnesium.
10. Circulating Pump:
    a. UL 778, all-bronze, centrifugal, in-line pump.
11. Acceptable Manufacturers:
    a. HTP
    b. Laars
    c. Lochinvar
    ~~d. Raypak~~
    e. RBI

E. INSTANTANEOUS, GAS WATER HEATERS
1. Instantaneous water heater complying with ANSI Z21.10.3/CSA 4.3, except storage is not required.
2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
    a. Heat Exchanger: Copper tubing.
    b. Insulation: Comply with ASHRAE/IESNA 90.1-latest edition.
    c. Burner: For use with tankless water heaters and for natural-gas fuel.
    d. Automatic Ignition.
    e. Adjustable thermostat.
    f. Metal with enameled finish.
3. Support bracket for wall mounting.
4. Acceptable Manufacturers:
    a. Bosch
    b. Noritz
    c. Paloma
    d. Takagi
    e. Rinnai

F. BRAZED PLATE HEAT EXCHANGERS
1. Double wall style with interstitial space vented to atmosphere,
2. Stainless steel construction meeting requirements for potable domestic water applications.

3. Specify for specific fluid temeperature and pressure applications.
4. Acceptable Manufacturers:
    a. Brazetek
    b. ITT Bell & Gossett
    c. Taco, Inc.

G. HOT WATER STORAGE TANKS
1. ASME-code steel with 150 psig minimum working-pressure rating where connected to systems with an input rating greater that 199,999 btu/h.
2. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets; anode-less materials are preferred, otherwise specify with replaceable anode rods for corrosion protection.
3. Steel exterior jacket with enameled finish.
4. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
5. Specify access manway or cleanout opening to facilitate servicing and inspection.
6. Specify with drain valve and combination pressure/temperature relief valve.
7. Acceptable Manufacturers:
    a. HTP
    b. Lochinvar
    ~~c. PVI~~
    d. Wessels

H. EXPANSION TANKS
1. Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
2. Acceptable Manufacturers:
    a. Amtrol, Inc.
    b. Calefactio.
    c. Watts Water Technologies Co.
    d. Wessels Co.

END OF SECTION

SECTION 22 40 13

PLUMBING FIXTURES AND TRIM

PART 1- GENERAL

A. WORK INCLUDED
    1. Fixtures and Trim:
        a. Plumbing Fixtures
        b. Water Coolers and Drinking Fountains
        c. Carries, Trim and Accessory Items
        d. Shower Valves, Systems and Bases
    2. Water Conservation Fixtures:
        a. All flush valve water closets shall be specified to not exceed 1.28 gallons per flush.
        b. All urinals shall be specified to not exceed 0.125 gallon per flush.
        c. The engineer shall specify manufacturers which meet this ultra low water usage criteria. Not all manufacturers listed in this specification currently meet this criteria. As manufacturers design their product to meet this ultra low water usage criteria, they may be included in the Engineer's specifications as acceptable manufacturers following review and approval by the District.
B. SUBMITTALS
    1. Product Data:
        a. Plumbing Fixtures
        b. Water Coolers and Drinking Fountains
        c. Carriers, Trim and Accessory Items
        d. Showers and Shower Bases
    2. Operating and Maintenance Data:
        a. Plumbing Fixtures:
        b. Water Coolers and Drinking Fountains
        c. Carriers, Trim and Accessory Items
        d. Showers and Shower Bases

PART 2- PRODUCTS

A. ACCEPTABLE MANUFACTURERS
    1. Cast Iron and Vitreous China Fixtures and Trim:
        a. Kohler
        b. American Standard
        c. Toto
        d. Sloan
    2. Multi-Station Lavatory Systems and Lavatory Decks:
        a. Bradley
        b. Sloan
        c. Willoughby Industries.

3. Stainless Steel Fixtures and Trim:
    a. Elkay
    b. Just
4. Electric Water Cooler/Drinking Fountains:
    a. Sloan
    b. Elkay (preferred)
    c. Halsey Taylor
5. Mechanical and Electronic Flush Valves:
    a. Sloan
    b. Kohler
    c. TOTO
6. Closet Seats:
    a. Kohler
    b. Church
    c. Olsonite
    d. Beneke
7. Mop Basins and Shower bases
    a. Fiat
    b. Sterns Williams
    c. Florestone
8. Faucets:
    a. Lavatory Electronic Metering:
        1). Chicago Faucet Co.
        2). Kohler
        3). Sloan Basys (Preferred)
        4). T&S Brass.
    b. Lavatory Mixing:
        1). Chicago Faucet Co.
        2). T&S Brass.
        3). Delta HDF Commercial.
        4). Kohler.
    c. Sink Mixing
        1). Chicago Faucet Co.
        2). T&S Brass
        3). Delta HDF Commercial
        4). Elkay
        5). Just
9. Shower Valves and Systems:
    a. Bradley
    b. Acorn
    c. Sloan (PWT)
10. Emergency Plumbing Fixtures:
    a. Acorn
    b. Bradley

c. Haws

11. Fixture Support Carriers:
    a. Jay R. Smith
    b. Josam
    c. Wade

B. PLUMBING ACCESSORIES
1. Accessories:
    a. Traps: Provide each fixture with trap, easily removable for servicing and cleaning. Provide 17 gauge cast brass P-tap with cleanout for each lavatory and sink, except as specifically noted.
    b. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheon.
    c. Provide hose faucets and hose connections with vacuum breakers.
    d. Finish wall and floor penetrations with set screw type chrome plated cast brass escutcheons.
    e. Cover fixture bolts with china bolt caps of the same color as the fixture and set in place with plaster of paris.
    f. All supply valves shall have renewable seats.
    g. All water supplies to fixtures shall be provided with quarter-turn stops.

C. FIXTURE REQUIREMENTS
1. All water closet and urinal spuds shall be brass, plastic spud inlets will not be allowed.
2. Specify multi-station lavatory systems with integral spray and sensor; installations within new construction shall be specified as hard wired, specify battery powered units for retrofit applications where power connections have not been previously provided.
3. Flush Valves:
    a. Specify flush valves with electronic actuation unless specifically directed otherwise by district staff.
    b. Specify side mounted operators for electronic flush valves.
    c. Specify hard wired flush valves in new construction projects, battery powered units in areas where retro-fit valves are to be installed.
4. Faucets:
    a. Lavatory faucets shall be specified with hard wired power connections in all new construction projects. Specify battery powered units in all retrofit applications.
    b. Coordinate with district staff for specific style of manual faucets at lavatory locations, electronic metering style lavatory faucets are preferred however, manual faucets may be required by the jurisdictional health department in certain locations.
    c. Specify sink faucets to meet the program requirements, coordinate with district staff prior to making final selections; double compartment sinks for use by students should be specified with restricted swing spouts to prevent over-rotation and resultant water damage.

5. Electric Water Coolers and Drinking Fountains:
    a. Specify electric water coolers with bottle fillers nearby main building entries, athletic facilities and common student gathering spaces.
    b. Specify drinking fountains only in classroom wings and similar low occupancy spaces.
    c. Coordinate specific locations with district staff for retro-fit applications.
6. Shower Valves and Systems:
    a. Specify individual shower valves at all coaches areas.
    b. Coordinate with district staff for multi-user shower stations; coordinate with health authority and architect for floor slope and required drainage system connections.
    c. Specify electronic shower systems with timer control in areas subject to continuous use (pool and athletic locker spaces).
    d. Specify shower bases as directed by the architectural design, shower bases for accessible shower stalls shall be designed to comply with current accessibility standards; where sloped threshold may allow for water to collect outside the shower enclosure, specify a floor drain to be installed.
7. Emergency Fixtures:
    a. Specify emergency fixtures at locations and counts required for compliance with ANSI and OSHA requirements.
    b. Specify mixing valves with flow capacities meeting the flow requirements for individual or combination fixtures.
    c. Investigate options for recessed or concealed equipment rather than exposed pedestal mounted equipment. District preference is to have equipment within student use areas recessed to minimize on vandalism.
8. Fixture Support Carriers:
    a. Coordinate chase and wall thicknesses to allow for proper fixture carrier and piping installation.
    b. All individual wall hung lavatory bowls shall be specified with concealed arm carriers. Secure vertical uprights to floor with lag bolts in accordance with manufacturer's installation instructions.

END OF SECTION

SECTION 23 00 00

HVAC INTRODUCTION

PART 1 – GENERAL

A. OVERVIEW

1. This guideline specification is for the Consulting Engineers and outlines minimum requirements for the District. The Consulting Engineer should apply these guidelines consistent with the budget constraints. The Consulting Engineer must select among the mechanical systems, size and specific equipment and materials within the budget and design limits. The guidelines are based upon considerable experience with the purpose of providing the best values for the available money.
2. Sections of these guidelines include specific specification requirements in addition to design requirements. The Consulting Engineer shall review these guidelines and incorporate specific specification requirements as needed to meet specific project requirements.

B. DESIGN
1. The Consulting Engineer is required to provide a complete and workable design. The consulting Engineer is responsible and accountable for his/her work. If in the opinion of the Consulting Engineer any portion of these guideline specifications or system performance function will not be complied with, the Engineer with notify the District in writing.

C. SUBMITTALS AND O&M MANUALS
1. Consultant shall pay particular attention to the submittals and O&M Manual requirements. In addition to O&M manual data, provide all performance data, including Fan curves, pump curves, electrical characteristics, complete nomenclature, list all options furnished with equipment and equipment startup reports.

D. RESTRICTIONS AND CRITICAL CRITERIA
1. Building Design: Architectural and engineering design shall accommodate the largest and heaviest equipment listed. This shall include structural loading, mechanical service clearances and provisions for replacement of equipment.
2. Coordination: Coordinate between Fire Alarm, Electrical, Temperature Control and mechanical for combination fire/smoke and smoke dampers, including actuator type. Provide in the coordination schedule these actuators as a specific line item. The control of the fire/smoke and smoke dampers shall be by Electrical.

E. DISTRICT REVIEW
1. The review of the documents by the District is intended to assist the Consulting Engineer to comply with the guideline specification. The District's review does not relieve the Consulting Engineer of the responsibility, accountability, completeness, and workability of the design.
2. Review Policy: Documents reviewed by the District shall be prepared in the form of red-lined plans and annotated specifications. The Consulting Engineer shall then review these documents.
3. Notification of non-compliance: When any portion of the guideline specifications will not be met, the Consultant shall notify the School District in writing.
4. No deviations to the Guideline Specification shall be accepted after final review.

END OF SECTION

SECTION 23 00 01

MECHANICAL AND ELECTRICAL COORDINATION

PART 1 – GENERAL

A. Provisions of the General Conditions, Supplementary Conditions and Division 1 – General Requirements, and applicable provisions elsewhere in the contract documents that apply to the work of Divisions 21 through 23.
B. Check and review the Electrical and Mechanical Drawings and Specifications to assure coordination with Divisions 21 through 23 and 26 through 28. Any errors and/ or omissions noted between Divisions 21 through 23 and 26 through 28 shall be brought to the attentions of the Architect for his decision.
C. The Divisions 21 through 23 Contractor(s) shall verify electrical service provided by the Electrical Contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals for all mechanical equipment to Divisions 26 through 28 Contractor(s). Final responsibility for properly coordinating the electrical work of this Section belongs to the Divisions 21 through 23 System Contractor(s) performing the work which requires electrical power.
    1. It shall be the responsibility of the Divisions 21 through 23 Contractor(s) to transmit to the General Contractor prior to starting work, all changes of electrical characteristics which result from any substitution of equipment. Any and all charges for such changes shall be the responsibility of the Divisions 21 through 23 Contractor(s) performing the work.

PART 2 – DESCRIPTION

A. Responsibility: All motors and controls shall be furnished, set in place, and wired in accordance with the following schedule.

ITEM	**FURNISHED BY**	**SET BY**	**POWER WIRING**	**CONTROL WIRING**
Manual Operating & Speed Switches, (carrying load currents) (see notes 3&4	MC	EC	EC	EC
Control Relays & Transformer (See Note 2)	TC	TC	EC	TC
Interface of Mechanical Systems & Devices with Fire Alarm System	EC	EC	EC	EC
Thermostats (Line Voltage) see Note 6	TC	TC	EC	EC
Temperature Control Panels (see Note 9a)	TC	TC	EC	TC
Fire & Smoke Detectors including Relays for Fan Shutdown (see Note 7&8)	EC	EC	EC	EC
Smoke Dampers and Combination Fire Smoke Dampers (see Note 7)	MC	MC	EC	EC
Motor & Solenoid Valves, Damper Motors, Control Valves, Fan Interlocking, Wiring, Low Voltage Thermostats	TC	TC	TC	TC
Freezestats, Aquastats TC Flow Switches	TC	MC	--	TC
Pushbutton Stations & Pilot Lights (manually operated Switches not carrying load currents) (see Note 3)	EC	EC	--	MC
Boiler & Water Heater Controls Including F.I.A. Gas Train	MC	MC	EC	TC
Temporary Heating Connect	MC	MV	EC	TC
Heat Type	EC	EC	EC	EC
Variable Frequency Drives	MC	EC	EC	TC

MC= Mechanical Contractor

Under Divisions 21 thought 23 Contractor who furnishes the work.

EC= Electrical Contractor

Under Divisions 26 through 28 Contractor who furnishes the work.

TC= Temperature Control Contractor

Under Division 23 09 00 Contractor who furnishes the work.

Notes:

1. All starters shall be furnished under Division 21 through 23 and shall be complete with O.L. heaters and shall conform to NEC and NEMA requirements.
2. Control relays and control transformers shall be furnished under Division 23 except where furnishing such items are specifically required under Division 26 through 28 Specifications and/or drawings.
3. Push button stations carrying full load current are to be wired under Division 26 through 28 of the work.
4. Exhaust fans: The electrical Contractor under Division 26 through 28 of the work will furnish and install circuits, feeders and disconnect switches, and make all connections to motors and controls. Where exhaust fans are switched with lights, a two-pole toggle switch will be provided by the Electrical Contractor under Divisions 26 to 28. Where exhaust fans are controlled by sixty (60) minute timer switches, electrical contractor shall provide and install the switch(es). Where exhaust fans are interlocked with other mechanical equipment, Temperature Control Contractor under Division 23 will furnish the interlock wiring.
5. If disconnect switches are furnished as part of factory wired equipment, wiring and connections only by EC.
6. If float switches, line thermostats, time switches, etc., carry the FULL LOAD CURRENT to any motor, or heating element or other similar item, Temperature Control Contractor under Division 23 shall furnish them. They shall be set in place and connected under the Electrical Division, except that where such items are an integral part of the mechanical equipment or directly attached to ducts, piping, etc., they shall be set in place under the MC and connected by the EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place, and wired under Division 23.
7. Wiring from alarm contacts to alarm system by EC, all control function wiring by TC. Smoke dampers and combination fire smoke damper actuators shall be 110 Volt.
8. Fire and smoke detectors in ductwork on mechanical equipment are mounted under MC. All other are mounted under EC. Locations to be determined by EC (Fire Alarm Sub).
    a. Electrical Contractor shall coordinate quantity and location of mechanical control panels with mechanical plans and specifications and with Mechanical Contractor. Provide a 120 Volt, 1-phase dedicated circuit from each control panel on group of control cabinets to the nearest panel board of correct voltage characteristics.

    b. Connections: Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

9. Mechanical Contractor shall not fabricate ductwork until he has inspected the space in which the ductwork will be installed, coordinated the location of ductwork with the light fixtures to be installed by the Electrical subcontractor, and assured himself that all ductwork will fit the space provided. Electrical Contractor shall transmit final approved shop drawings and product data showing sizes, heights and locations of light fixtures to the General Contractor and Mechanical Contractor to properly allow this coordination to take place. Also transmit for

coordination purposes the shop/layout to allow proper installation of mechanical and electrical equipment in mechanical and electrical rooms and other such areas.

END OF SECTION

SECTION 23 00 02

HVAC DESIGN CRITERIA AND SYSTEMS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. General Mechanical Systems, Standards and Design Criteria.

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Adhere to the most recent edition of the codes and standards listed in Sections 21, 22 and 23. Together with the latest revisions, supplements, and amendments. Should a conflict exist between the guide spec and codes or standards, the Consultant shall notify the District.
   2. Ventilation
      a. Comply with ANSI/ASHRAE 62-2010 “Ventilation for Acceptable Indoor Air Quality”, or as required by most recent adopted mechanical code.
   3. Machine Rooms
      a. Comply with IMC and ASHRAE Standards 15 – 1992. Emphasis shall be placed on:
         1. Oxygen deprivation sensor for A1 refrigerants or a refrigerant sensor for B1.
         2. Mechanical ventilation.
         3. Purge and relief valve.
         4. Equipment room alarm.
   4. Accessibility
      a. All control devices shall be installed in a readily accessible location as defined in the current edition of the NEC Chapter 1, article 100.
   5. Renovation of Existing Buildings
      a. Confer with the District prior to design of mechanical systems.
   6. Design Criteria
      a. Temperature
         1. Temperature outside:
            i. Cooling – (95° F db/ 59° F wb)
            ii. Heating – (-10° F)
         2. Temperature Inside Occupied Mode: (General)
            i. Cooling – 74°F (± 2.0° F)
            ii. Heating – 71°F (± 2.0° F)
         3. Temperature inside – Unoccupied Mode: (General)
            i. Cooling – none
            ii. Heating – 65° F
      b. Ventilation
         1. Comply with ANSI/ASHRAE standards 62.1-2010 Ventilation for acceptable Indoor air Quality and ANSI/ASHRAE/IESNA Standard 90.1-2010, Energy Standard for Buildings, Expect Low-Rise Residential Buildings. Design ventilation systems to meet or exceed the minimum outdoor ventilation rates as described in the ASHRAE standard. The impact of the ventilation rates on energy use and indoor quality shall be balanced to optimize energy efficiency and occupant health. Use CO2- based demand-controlled ventilation to reduce the total supply of outdoor air during periods of reduced occupancy. Use the ASHRAE 62 User’s Manual for detailed guidance on meeting the referenced requirements. The number of occupants for each space to be verified the with Owner by the Engineer/Architect.
         2. Ventilation shall be designed as noted above and include requirements mandated by most recently adopted mechanical code and energy conservation code.
      c. Background Sound Levels:

1. Comply with methodology listed in the 2011 HVAC Applications Handbook, Chapter 47, on Sound and Vibration Control to achieve RC levels listed below.
2. Classrooms
    i. NC – 25 to 30(N)
    ii. RC – 25 to 30
    iii. dBA – 45- 50
3. Gymnasiums and Cafeterias
    i. NC – 30 to 35 (N)
    ii. RC – 30 to 35
4. Offices and Conference Rooms
    i. NC – 25 to 35(N)
    ii. RC – 25 to 35
5. Auditoriums and pools: design criteria by Acoustic Specialist

d. Exterior Sound Levels:
    1. Refer to 200548 for additional requirements.
    2. For equipment located outdoors comply with local noise level requirements as defined by local jurisdiction and code official. Review equipment sound power levels with District Project Manager for specific requirements for sound power levels in noise critical areas.
    3. Identify specific sound power requirements for sound power levels on construction documents including measurement distance or location, specific reflective considerations such as walls and enclosures, and specific sound power reduction methods of attenuation.
e. Zone control: all occupied spaces shall have individual room control.
f. All new mechanical systems shall include economizer functions. Air side economizer functions shall be included for all air handling systems 5-tons (nominal) and above. Review with the District for chilled water plant economizer options.

7. Energy Efficiency
    a. At minimum comply with design standards outlined in ASHRAE Standard 90.1.
    b. For new facilities, additions, and major remodeling projects, the design team may be directed to coordinate and work with Xcel Energy and participate in Xcel's Energy Design Assistance (EDA) program.
    c. For all projects including equipment replacements, the design team shall provide design compliant with Xcel Energy's rebate program. The design team shall work with Xcel energy and the District to outline specific requirements for the scope of work. Review with the District for electrical and natural gas services for which rebate program to incorporate.
    d. The design team shall assist the contractor in applying for and processing the documentation necessary for the Xcel Energy rebate program.

C. DESIGN PARAMETERS

1. Central Cooling Plant: For Buildings with chilled water systems which do not use ice storage systems, the chiller(s) shall be selected to operate at a 10 to 12° F Delta T and the chilled water coils for a 10 to 12° F Delta T. The system chilled water pump shall be sized to accommodate the entire connected load. Single chiller systems shall be configured with reverse return, and variable flow primary. Variable flow primary shall reduce flow in the

system to30% total connected load or chiller minimum whichever is greater. Multiple chiller systems shall utilize primary secondary configurations with constant flow primary pumps and variable flow secondary pumps. Configure chilled water plant with variable flow secondary pumping to reduce flow to 30% of connected load. Chiller operation shall be such that a single chiller may operate during low load periods.

2. For Middle Schools and High Schools, the chilled water piping system shall use VFD's for chilled water pumps in the primary chilled water loop. Both 2-way and 3-way valves shall be used. The minimum flow rate shall not be less than 30% of the total connected load, as required by the international energy conservation code, or chillers(s) required minimum whichever is greater. The primary chilled water pump shall be sized to accommodate the entire connected load.
3. For all buildings, the primary HW loop shall be reverse return with VFD's for HW pumps. Systems shall be designed to use 2-way and 3-way valves. The minimum water flow shall be 30% of maximum connected load, or as required by the international energy conservation code. The primary heating water pump shall be sized to accommodate the entire connected load.
4. Boilers:
    a. Non-Condensing Boiler Plants: Each boiler shall have a dedicated (BCP) boiler circ. pump. BCP capacity shall match the boiler output Delta T and design. The capacity of each primary HWP shall match the total connected load. Boilers shall be piped in reverse-return method with full pipe size by-pass with isolation valves for each boiler. Each boiler shall be furnished with two low water cut-off safety switches. Boilers for new construction shall be condensing type. For remodel work which involves boiler replacement, the Engineer shall review the existing heating system and ascertain if it feasible to use condensing boilers.
    b. Condensing Boiler Plants: Condensing boiler plants shall utilize a variable flow primary system incorporating two variable flow primary pumps each sized to match the building connected load. Boiler system piping shall be reverse return to equalize flow through the boilers. Each boiler shall be furnished with a low water cut-off safety switch.

D. MECHCANICAL SYSTEMS (IN ORDER OF PREFERENCE) – ELEMENTARY SCHOOLS
    1. System No. 1 (Base system)
        a. Major components: Air cooled liquid chiller multiple indoor VAV (variable air volume) air handling units for multi-zone areas, and SZVAV (single zone vav) for large single spaces such as auditoriums, gymnasiums, and cafeterias, two gas fired condensing type boilers with power burners, DX split system (for administration), direct digital temperature control system.
        b. Air Side: All AHU's shall have full air side economizer capability. For building with crawl spaces, AHU's will be located in crawl spaces. Coordinate with Architect to provide adequate space for service and equipment replacement.
            1. Separate VAV AHU with both chilled water and DX coils shall serve the administration area. Related condensing unit shall be located in the crawl space. Provide individual VAV terminal unites (TU's) with HW heating coils for room control.
            2. SZVAV AHU shall serve a single space such as the multi-purpose room. Unit shall be designed to maintain space temperature by modulating supply air volume and discharge air temperature to meet space loads.
            3. VAV AHU's shall serve the remainder of the school. Provide individual VAV TU's with hydronic heating coils for room control.
        c. Mechanical cooling: Chiller shall provide chilled water for the entire school. During periods when only administration area is occupied, the DX system shall provide cooling for the AHU. To minimize noise concerns, the air-cooled liquid chiller will be carefully

located on the site. Consideration shall be given to locating the chiller below grade in its own enclosure, if a suitable above grade location is not available.

d. Heating
    1. Two gas fired condensing type boilers shall provide hot water for building heating. Each boiler to be sized to accommodate 67% of the total building heating load.
    2. Provide two heating water pumps. One pump shall be the primary pump, and the second pump shall be the stand-by pump. Either pump to be sized to accommodate the total conned load.
e. Air distribution: For classrooms, use conventional overhead supply distribution system.

E. MECHANICAL SYSTEMS - MIDDLE SCHOOLS
1. System No.1 (Base system)
    a. Major components: water or air cooled liquid chiller, cooling tower, multiple indoor VAV (variable air volume) air handling units for multi-zone areas, and SZVAV (single zone vav) for large single spaces such as auditoriums, gymnasiums, and cafeterias, two gas fired condensing type boilers with power burners, DX split system (for administration), direct digital temperature control system.
    b. Air Side: All AHUs shall have full air side economizer capability. For buildings with crawl spaces; AHU's, water cooled chiller and ice storage system, will be located in the crawl spaces. Coordinate with Architect to provide adequate space for service and equipment replacement.
        1. Separate VAV AHU with both chilled water and DX coils shall serve the administration area. Related condensing unit to be in the crawl space. Provide individual VAV terminal units (TU's) with HW heating Coils for room control.
        2. SZVAV air handling shall serve the multi-purpose rooms, gymnasiums, auditoriums, etc. Unit shall be designed to maintain space temperature by modulating supply air volume and discharge air temperature to meet space loads.
        3. VAV air handling units shall serve the remainder of the school. Provide individual VAV TUs with heating coils for room control.
    c. Mechanical Cooling: Chiller shall provide chilled water for the system which serves the entire school. During periods when only the administration area is occupied, the DX system shall provide cooling for the AHU. Due to noise concerns, the air-cooled liquid chiller may have to be located below grade in its own enclosure.
    d. Heating
        1. Two or three gas fired condensing type boilers shall provide hot water for building heating. If two boilers are used, each boiler shall be sized to accommodate 67% of the total building heating load. If three boilers are used, each boiler shall be sized to accommodate 35 to 45% of the total building heating load.
        2. Provide two main heating water pumps. One pump shall be the primary pump, and the second pump shall be the stand-by pump. Either main pump shall be sized to accommodate the total connected load. Arrange boiler piping to be reverse return. Where required for three boilers provide boiler isolation valves to prevent circulation of un-heated water through disabled boiler. Isolation valves shall be interlocked with boiler to open whenever boiler is enabled, and closed when boiler is disabled. Valve shall operate through boiler controls and remain open for a minimum of 5 minutes after boiler is disabled to prevent boiler overheating.
    e. Air distribution: For classrooms, use conventional overhead supply distribution system.

F. MECHANICAL SYSTEMS – HIGH SCHOOLS
1. System No. 1 (Base System)

a. Major components: Two water cooled liquid chillers, cooling tower, multiple indoor CV (constant volume) and VAV (variable air volume) air handling units, two gas fired condensing type boilers with power burners, DX split system, direct digital temperature control system.
b. Air Side: all AHUs shall have full air side economizer capability. For buildings with crawl spaces, all AHU's, water cooled chillers will be in the crawl spaces. Coordinate with Architect to provide adequate space for service and equipment.
    1. Separate VAV AHUs with chilled water: Provide individual VAV terminal units (TU's) with HW heating coils for room control.
    2. CV air handling shall serve that multi-purpose rooms, gymnasiums, auditoriums, etc...
    3. VAV air handing units shall serve the remainder of the school. Provide individual VAV TUs with heating coils for room control.
c. Mechanical Cooling: Chillers shall provide chilled water for the entire school, except for the administration area which shall be served by a single package DX RTU.
d. Heating
    1. Three gas fired boilers shall provide hot water for building heating. If three boilers are used, each boiler shall be sized to accommodate 35 to 45% of the total building heating load.
    2. Provide two main heating water pumps. One pump shall be the primary pump, and the second pump shall be the stand-by pump. Either main pump shall be sized to accommodate the total connected load. Arrange boiler to piping to be reverse return. Where required for three boilers provide boiler isolation valves to prevent circulation of un-heated water through disabled boiler. Isolation valves shall be interlocked with boiler to open whenever boiler is enabled, and closed when boiler is disabled. Valve shall operate through boiler controls and remain open for a minimum of 5 minutes after boiler is disabled to prevent boiler overheating.
e. Air distribution: For classrooms, use conventional overhead supply distribution system.

G. SPECIAL USE AREAS AND SYSTEMS
1. Communication Room: Provide 1.5-ton DX unit with remote condenser. Larger unit may be required, Engineer to verify equipment loads. Condensing unit to be in the crawl space.
2. Kitchen/Cafeteria: Comply with the requirements of NFPA 96. Area to be served by one AHU if feasible. Kitchen to be negative with respect to all areas, except related toilet rooms. Refrigeration units for walk-in cooler and freezer shall be split system. Condensing units to be in the crawl space when available, located on roof when no crawlspace is available. Refrigeration condensing units located at grade level are discouraged unless approved by the District.
3. Kitchen Make-up Air: Avoid make-up unit, if possible, obtain make-up air from AHU which serves kitchen and cafeteria. In the event make-up air is not adequate from the AHU, use a gas fired make-up air unit for tempered air to meet exhaust requirements for grease hood.
4. Pools: The use of solar water heating panels is not recommended and shall be avoided. If energy recovery is required by adopted mechanical code, provide condenser/compressor energy recovery loop.

H. DESIGN CONSIDERATIONS
1. No AHUs shall be located above ceilings.
2. Provide isolation valves at all branch run outs, at all equipment and sections of piping.
3. Provide strainers at all control valves.
4. Do not install piping in exterior walls.

5. AHU fans shall be belt drive whenever possible, avoid direct drive fans unless approved by the District. Small equipment fans such as exhaust fans, fan coil units, and fractional HP units may be direct drive. Specify direct drive fans for fans 1/2hp and smaller, use belt drive fans for 3/4hp and larger. Direct drive fans shall include speed control or ECM motors.
6. HWS/R piping shall be reverse return. Advise Owner if Consultant wishes to design system for direct return.
7. All connections made to existing chilled water, heating water and domestic water systems shall be made with isolation valves.
8. No pumps shall be located above ceilings.
9. System water pressure losses shall be designed with energy conservation in mind. Maximum water pressure drop (without diversity) for pipe sizing shall not exceed 3 feet per 100 feet and maximum velocity (without diversity) shall not exceed 8 feet per second. Care shall also be taken to keep water pressure drop for coils, chillers, heat exchangers and control valves as low as possible.
10. System air pressure losses shall be designed with energy conservation in mind. Maximum air pressure drop for main low-pressure ductwork shall not exceed 0.08 inches per 100 feet and maximum velocity shall not exceed 1,600 feet per minute. Acoustic constraints for sound critical areas such as Stages and Auditoriums may require lower duct velocities. Maximum air pressure drop (without diversity) for medium pressure ductwork shall not exceed 0.25 inches per 100 feet and maximum velocity (without diversity) shall not exceed 2,500 feet per minute. Care shall also be taken to keep air pressure drop for coils, heat exchangers, VAV Terminal Units, fire dampers, smoke dampers, combination fire/smoke dampers and duct fittings as low as possible.

END OF SECTION

SECTION 23 00 04

MECHANICAL MATERIALS AND METHODS

PART 1 – GENERAL

A. SUMMARY – SECTIONS INCLUDES
   1. Pipe Hangers and Supports
   2. Motors and Starters
   3. Pipe Installation
   4. Pressure Testing of Piping Systems
   5. Expansion Compensation
   6. Gauges

B. REFERENCED STANDARDS
   1. ANSI B31.1
   2. IEEE-112
   3. NEMA

C. SUBMITTALS
   1. Shop Drawings:
      a. Expansion joints, pipe guide and anchor layout.
   2. Product Data:
      a. Gages
      b. Hangers
      c. Expansion Joints
      d. Thermal Hanger Shields

D. CRITICAL CRITERIA/RESTRICTRICTIONS
   1. Pipe Installation:
      a. Install piping without springing or forcing, and clear windows, doors, and other openings.
      b. Provide sufficient swing joints, anchors, expansion loops and devices necessary to permit free expansion and contraction without causing undue stresses.
         1. The Consulting Engineer shall size expansion loops.
         2. Coordinate movement of building with Soils Engineer.
      c. Shut-Off Valves: Provide shut-off valves and unions suitably located, to isolate each item of equipment, branch circuit or section of piping. Visibly mark location of concealed valves.
      d. Provide dialectic nipples (equal to Victaulic style 47) or waterways for building heating water and chiller water systems. Provide isolation valve in steel pipe near dielectric nipple.
      e. Strainers: Provide strainers at all temperature control valves.
      f. Air Vents: Provide air vents at top of all coils and at high points in hydronic system. Coin operated air vents are not acceptable.
      g. Building Heating Water System: For pipes 2” and smaller unions shall be 250LB, black malleable iron with ground joint and brass seat. Provide brass ball valve to connect to copper piping. Dielectric unions not allowed.
      h. Connections: Screw joint steel piping up to and including 2”. Weld piping 2 1/2” and larger including branch connections.
         1. Make connections to equipment and branch mains with unions.
         2. All HWS&R run outs and branches shall be top take-off at 45°, bottom take-offs not allowed.
      i. Routes and Grades:

1. Slope water piping 1”in 40’ and arrange to drain at low points.
2. On closed systems, equip low points with drain valves and hose nipples. At high points, provide collecting chambers and automatic air vents.
3. Coordinate and verify all invert elevations, whether or not shown prior to excavation and installation of interior and exterior piping.
4. Locate all drain valves and air vents of “Record Drawings”.

2. Installation of Pipe Hangers: Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing. Providing support between piping and building structure where necessary to prevent swaying.
   a. Inserts: Specify calcium silicate pipe inserts for insulated pipe 1-1/2” and larger.
   b. Shields: Specify sheet metal shields for all piping 3/4” and larger. Shields shall be a minimum of 6” long. Shields for clevis type hangers shall be 180°, and shields for trapeze hangers shall be 360°.
   c. Specify pipe clamps for all pipes supported by trapeze type hangers.
   d. Pipe clamps shall clamp around insulation, and not to piping itself.
3. Expansion Compensation
   a. General: Provide flexible pipe connectors on pipes connected to equipment supported by vibration isolation.
   b. Expansion Loops: Provide expansion loops and offsets where required.
      1. Flexile hose type expansion loops are acceptable in lieu of hard piped expansion loops.
   c. Anchors: Securely anchor piping where indicated or where required for proper installation.
   d. Pipe Guides: Install pipe guides where indicated or where required for proper installation of expansions loops.
4. Gages:
   a. Locate bulb portion of socket in fluid flow and enlarge pipe as required so as not to restrict flow.
   b. Thermometers in insulated ducts shall have mounting flange reversed to bring mounting connections outside insulation. Thermometers to be digital, non-mercury housed.
   c. Provide thermometers and gages as follows:
      1. Provide thermometers in heating water system as follows:
         i. Heating water supply and return mains.
         ii. Boiler(s) inlet and outlet.
      2. Provide thermometers in chilled water and condenser water supply and return system mains. Exact location to be determined by the Engineer if not indicated on drawings.
      3. Provide gauges at suction and discharge of each primary chilled water pump, heating water pump and condenser water pump.
5. Equipment Bases and Supports
   a. Vibration Isolation Bases: See Section 23 05 48.
   b. Housekeeping Bases: Concrete bases are required for all floor mounted equipment provided under Division 21, 22 and 23.
6. Piping System Testing
   a. Test procedures:
      1. Heating hot water piping, condenser water piping, chilled water piping, steam and condensate return lines: 120 PSIG hydrostatic tests.
      2. Hold hydrostatic tests for a minimum of eight (8) hours without loss of pressure. Hydrostatic test pressure shall be measured at the low pint of the individual system or done being tested. Hold air tests for a minimum of one (1) hour without loss of pressure.

b. Retesting: Retest piping failing initial tests following correction of defective work. Requirements of initial tests shall apply.
c. Test Report: The test report shall contain the following and be submitted within 7 days of each test:
    1. Date, time, and place of test.
    2. Duration of test
    3. Persons responsible for testing
    4. Results of test
    5. Action taken to correct deficiency.
    6. Outside air dry bulb temperature
    7. Specific section of piping tested.

PART 2 – PRODUCTS

A. PIPE HANGERS AND SUPPORTS
    1. General: Comply with “The Code for Pressure Piping, ANSI B31.1, with Addenda 31.1 Oa-69”.
    2. Insulated Pipe Supports: Protect all insulated pipe at point of support with hanger shields. Shields shall be minimum 180° and 6” long. Protect all insulated pipe 1-1/4” and larger with thermal hanger inserts. Thermal hanger inserts shall consist of a 180 degree insert for clevis type hangers, and 360 degree insert for trapeze hangers, of high density, 100 PSI, waterproof calcium silicate or equivalent.

B. EXPANSION CONPENSATION
    1. Acceptable Manufactures
        a. Hyspan
        b. Webster
        c. Resisto-Flex
        d. Thermo-tech
        e. MetraFlex
        f. Approved Substitute
    2. Radiation Expansions Joints: Designed for 100 PSI minimum working pressure of capable of accepting one inch (1”) of pipe expansion and 1/4” of pipe contraction for a total movement of 1-1/4”.
    3. Pipe Expansion Joints
        a. Steel Piping
            1. 3” and under: Stainless steel bellows type with anti-torque devices, limit stops and internal guide. Equal to Hyspan 8500 series.
            2. Over 3”: External ring-controlled type with hydraulically formed stainless steel bellows. Equal to Hyspan 3500 Series, 850°F.
        b. Copper piping: All bronze type with two-ply bronze bellows, anti-torque device limit stops, internal guides and solder joint end.
    4. Flexible Hose Expansion Loops:
        a. Copper Piping:
            1. Copper-alloy fittings with solder-joint end connections. Bronze hoses and single-braided bronze sheaths with 450 psi at 70°F and 340 psi at 450°f ratings.
            2. Provide union at each end of expansion loops to facilitate removal of loop.
        b. Steel Piping:
            1. Carbon-steel fittings with threaded end connections for 2” and smaller, and flanged end connections for 2-1/2” and larger. Stainless steel hoses and single braid, stainless steel sheaths with 200 psig at 70°F and 145 psi at 600°
            2. Welded pipe connections at expansion loops are not permitted.

C. MOTORS AND STARTERS
1. Manufacturers:
    a. All motors shall be as manufactured by approved manufacture.
    b. ABB
    c. Baldor
    d. General Electric
    e. Lincoln
    f. Reliance
    g. Toshiba
    h. TECO – Westinghouse
    i. US Motors
    j. WEG
2. Motor 3/4 HP and larger shall be 480 Volt, Three-Phase, 60 Hertz, 1800 and/or 1,200 RPM with OPD enclosure. Motors shall be designed for quiet continuous operation with 40°C rise above ambient at full load, service factor of 1.15, copper windings, class B or F insulation.
3. Motors used with Variable Frequency Controllers shall have ratings, characteristics and features coordinated with approved by the VFD controller and manufacturer.
    a. Motor shall be designed with critical vibration frequencies outside operating range of controller output.
    b. Insulation class shall be Class H, same as Class B, except with silicone resin binders.
    c. Comply with NEMA MG 1 requirements for thermally protected motors.
    d. All motors 7-1/2hp and above which utilize VFD's shall include shaft grounding rings for motor bearing protection.
4. All motors shall have conduit connection boxes and permanently sealed prepublication ball bearings using grease for operation at -30°F. They shall open drip proof, standard NEMA frame, normal duty, and normal starting torque unless otherwise noted.
    a. The nameplate horsepower rating without consideration of the service factor shall not be exceeded at any point along the performance curve of any pump at its rated RPM.
    b. Bearings: Double shielded ball in accordance with ANSI B3.16
    c. Motor wiring: Terminate in a NEMA terminal box mounted on the motor case and of the manufactures standard size. The terminal box shall have a bolt type copper ground connector.
    d. Motors 1/2 HP or less may be split capacitor single phase with sleeve bearings or ECM type, and shall be a standard frame size and RPM, available from more than one manufacture.
    e. Ascertain and/or Engineer before ordering equipment or work.
    f. Motor efficiency shall conform to IEEE-112 and NEMA Chart 12-10.
    g. Power factor for all motors 2 HP and larger shall have a minimum power factor of 0.90. All motors shall comply with requirements outlined in most recent adopted version of the Energy Conservation Code.
5. For single phase direct drive motors specify solid state electronic speed control or ECM motor for balancing.
6. Starters for small motors without starts shall have thermal overload protection in each phase. All magnetic starts to be furnished with transformers to provide 120C control voltage. Where 120V control may be established by crossing line voltage and neutral (if available), or it is specifically indicated to be obtained by some other means, control transformers may be omitted. All motors over 10 horsepower shall have reduced voltage starters.
    a. Starters shall be Allen Bradley, Cutler-Hammer, Furnas or Square-D standard magnetic contractor-type with HAND-OFF-Auto switch, overload heaters, 120V control transformer, and single-phase protection, under voltage protection and square N.O. and N.C.

contracts for control by Division 23. NEMA enclosure appropriate for the service or 3R for wet areas.

b. Use magnetic starts for motors 3/4 HP and larger.
c. Electrical materials and methods shall be in accordance with the provisions of Division 26.

D. GAUGES
1. Temperature Gauges: Description – die-cast with baked enamel finish, digital read-out, adjustable multi-angle housing, and brass separable socket. Note: Mercury filled gauges are not allowed.
2. Pressure Gauges: Description – phenolic turret case, 4 1/2 “dial with suitable ranges, phosphor-bronze bourdon tube, corrosion resistant movement, adjustable stainless-steel pointer, 1% of full-scale accuracy, ¼“ NPT brass connection. Furnish ¼ “brass needle valve and pressure snubber with each pressure gauge.

END OF SECTION

SECTION 23 05 23

HVAC VALVES AND SPECIALTIES

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUES
   1. HVAC Valves and Specialties:
      a. Valves
      b. Specialties

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Reference Standards: Comply with applicable requirements of the following standards:
      a. Nation Certificated Pipe Welding Bureau (NCPWB)
      b. ASME Boiler Pressure Code
      c. American Water Works Association (AWWA)
      d. ANSI B31 Code for Pressure Piping
      e. Underwriters'' Laboratories, Inc. (UL)
      f. International Building Code
      g. National Fire Protection Association (NFPA)
      h. National Electrical Manufacturer's Association (NEMA)
      i. National Electrical Code (NEC)
      j. American Welding Society (AWS)
      k. American National Standards Institute (ANSI)

C. SUBMITTALS
   1. Product Data:
      a. Valves
      b. Specialties
   2. Operating and Maintenance Data:
      a. Valves
      b. Specialties

D. RESTRICTIONS/ CRITICAL CRITERIA
   1. Valves
      a. Install ball valve or butterfly valve for shut-off and isolation service, to isolate equipment, parts of system or vertical risers.
      b. Provide drain valves at main shut-off valves, low points of piping and apparatus.

PART 2 – PRODUCTS

A. VALVES
   1. Acceptable Manufactures
      a. Keystone
      b. Dezurick
      c. Nibco
      d. Grinnell
      e. Stockham
      f. Apollo
      g. Hammond
      h. Kitz

   2. General: All valves of a given type shall be of one (1) manufacture and shall be listed with the Manufactures' Standardization Society of the Valve and Fittings Industry.

3. Valve Connections:
    a. Provide Valves suitable to connect to adjoining piping as specified for pipe joints.
    b. Thread pipe sizes 2” and smaller.
    c. Flange pipe size 2½” and larger.
    d. Solder or screw to solder adapters for copper tubing.
    e. Provide butterfly valve with tapped lug body when used for isolating service.
4. Ball Valves: Bronze, full port, chrome plated bronze ball with Teflon seats, 150 WSP, 400 WOG, screwed or soldered ends. Ball valves located in steel pipe shall have stainless steel ball.
5. Butterfly Valves:
    a. 2-1/2 through 5”: Cast iron body, full-lug type, extended neck, stainless steel stems, EPDM elastomer seat, aluminum-bronze disk, lever lock handle with toothed plate and position lock. Valve shall be bubble tight up to 175 PSI. Valves shall be rated for bi-directional deal-end service to full working pressure of the valve with downstream flange removed.
    b. 6” and larger: Cast iron body, full-lug type, extended neck, stainless steel shaft, EPDM elastomer seat, aluminum-bronze disk, gear actuator with disc position indicator. Valve shall be bubble tight up to 175 PSI. Valves shall be rated for bi-directional dead-end service to full working pressure of the valve with downstream flange removed.
6. Drain Valves: Ball valve with GHT male end and chained cap.
7. Balancing Valves: Tight close-off, adjustable memory, 175 PSIGN. Eccentric valves shall be used.
8. Eccentric Valves: Corrosion resistant plug, permanently lubricated, corrosion resistant bearings, EPDM seals, 175 WOG, flanged ends, lever operator for valves 3” and smaller. Worm gear actuator for valves 4” and larger. Valves for balancing service shall have adjustable memory stops.
9. Check Valves:
    a. Swing check valves:
        1. 2” and smaller: Bronze horizontal swing disc, renewable Teflon disc, solder or screwed ends, 150 lbs. WPS, 300 WOG.
        2. 2½” and larger: Cast iron body, bronze trim, horizontal swing disc, renewable bronze and seat, flanged ends, 125 lb. WSP, 200 WOG, bolted bonnet.
    b. Spring loaded silent check valves: Cast iron body, bronze trim, spring loaded, wafer type with field replaceable EPDM seat, stainless steel springs, 125 lb. WPS.
10. Valve Operators:
    a. Provide suitable lever handle for butterfly valves.
    b. Provide chain operators for valves 4” and larger located more than 7 feet from floor in equipment rooms. Extend chains to 5 feet from floor and hook to clips arranged to clear aisles.
    c. Provide handle extensions for insulated piping.
11. Pressure Ratings: Unless otherwise indicated, use valves suitable for minimum 125 PSIG working steam pressure at 450*F and 200 PSIG non-shock cold water.

B. SPECIALTIES
1. Strainers:
    a. Acceptable Manufactures:
        1. Bell and Gossett
        2. Amtrol
        3. Taco
        4. Thrush
        5. Apollo Valves
        6. Conbraco

7. Crane Co.
8. Hammond Valve
9. Milwaukee Valve Company

2. Pressure and Temperature Relief Valves:
   a. Acceptable Manufactures:
      1. Watts
      2. Bell & Gossett
      3. McDonnell-Miller

C. BALANCING FLOW METERS
   1. Stations:
      a. Manufacturers:
         1. Gerand
         2. Flowset
         3. ITT Bell & Gossett
         4. Taco
         5. Tyco Flow Control
         6. Flow Design Inc

      b. Sized such that design flows fall within the mid-range of the meter scale, with a maximum installed pressure drop of 2.0 feet.
         1. Through 4”: Flow set combination Venturi/ball valve. Full size handle grip and memory stop.
         2. Above 4”, Factory tested accuracy shall be 2%, low loss design, sized such that designed flows fall within the mid-range of the meter scale, with a maximum installed pressure drop of 2.0 feet. One portable meter shall be turned over to the Owner.
      c. Provide a metal identification tag with chain for each installed Venturi. The tag to be stamped with the unit or zone, Venturi model number, flowrate in GPM and differential pressure.
      d. Metering stations for over 4” shall be a Venturi with a separate balancing valve.

END OF SECTION

SECTION 23 05 48

MECHANICAL NOISE AND VIBRATION

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Sound Isolating Pads.
   2. Spring type isolators.
   3. Flexible Connections
   4. Acoustical Floor, Ceiling and Wall Seals.

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ASHRAE Guide

C. SUBMITTALS
   1. Shop Drawings and Product Data:
      a. Equipment Pads.
      b. Spring Type Isolators.
      c. Vibration Hangers.
      d. Flexible Connections.
      e. Acoustical Floor, Ceiling and Wall Seals.

D. RESTRICTIONS/ CRITICAL CRITERIA
   1. Structural Requirements: Design pad and isolator sizes for equipment loads including side loading.
   2. Acoustic Requirements: Provide and install vibration eliminators so that average noise criteria as outlined in ASHRAE guide are not exceeded.
   3. Provide vibration isolators for motor driven mechanical equipment unless specifically noted otherwise. As a minimum comply with ASHRAE Vibration Isolator Selection Guide and manufacturer's recommendations.
   4. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system here in specified. Electrical conduit connections to isolated equipment shall be looped to allow free motion of isolated equipment.
   5. Base Mounted Pumps: Vibration isolator manufacturer shall furnish rectangular structural beam or channel concrete forms for floating foundations. Bases for end suction pumps shall be large enough to provide support for suction diffuser. Bases shall be equal to Mason Type K and springs shall be equal to Mason Type SLF/
   6. Flexible connectors: Only EPDM materials are acceptable. Do not use devices with exterior metal braiding.
   7. Acoustical Floor, Ceiling and Wall Seal: Where piping passes through equipment walls, floors, or ceiling, provide a split seal to minimize the passage of noise though the seal and vibration to the structure. Seals shall be equal to Mason Type SWS.
   8. Exterior Equipment Requirements: For equipment located on roofs or on grade the design professional shall ensure radiated sound levels are minimized at the property line. District shall notify the design engineer of specific sound issues at existing locations.
      a. Refer to specific sound requirements at site location, and according to local sound ordinances. Limit sound levels to 50db(A) where facilities are located in residential areas, and 65db(A) in commercial areas, where specific sound criteria are not available.
      b. Sound mitigation measures shall include:
         1. Compressor insulating sound blankets for air cooled chillers and air handling equipment.

2. Low sound or low speed condenser fans (air cooled condenser, cooling towers, air cooled chillers.
3. Specify sound enclosures where specified equipment is not available with required sound attenuation packages. Define specific sound attenuation package requirements on contract documents. Requirements shall include estimated sound power levels at property line.

PART 2 – PRODUCTS

A. VIBRATION ISOLATORS
   1. Acceptable Manufactures:
      a. Mason Industries
      b. Consolidated Kinetics
      c. Amber-Booth

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES:
   1. Markers, tags and labels for mechanical pipes and equipment.

B. REFERENCED STANDARDS (MINIMUM CRITERIA):
   1. Comply with ANSI A13.1 - Identification of Piping Systems.

C. SUBMITTALS
   1. Shop drawings
      a. Pipe identification
      b. Valve tags
      c. Equipment identification

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Piping Identification
      a. General: Identify contents and direction of flow of piping in crawlspaces, above ceilings, etc., as well as exposed to view. Provide identifying markings at valves and equipment, at terminal points and at both sides of piping passing through walls and floors. In addition, provide identifying markings at 40’ on center.
      b. Stenciled Markings: Apply after completion of finished coat of paint. Wipe pipe clean. Perform stenciled-on markings without overspray, drips, or other imperfections.
      c. Pressure Sensitive Markers: Apply in accordance with manufacturer’s recommendations. Marker adhesion will be tested for permanence. Replace any markers showing dog-ears, bubbles, or other failings.
      d. Use an arrow marker with each pipe content stencil. The arrow shall always point away from the pipe stencil and in the direction of the flow; color and height of arrow to be same as content stencil. If flow can be both directions, use a bubble-headed arrow stencil.
      e. Apply pipe stencil and arrow stencil within 3” of each valve to show proper identification of pipe contents and direction of flow.
      f. Apply the stencil to the pipe so lettering is in the most legible position. For overhead piping, apply stencil on the lower half of the pipe where view is unobstructed, so stencil can be read from floor level.
   2. Valve Identification
      a. General: Identify main water service valves, including valves located inside the building for type of service. Identify valves and cocks controlling branch mains or risers to various portions of the building as the area served. Use tags secured with brass chains.
      b. Stamp valve tags with a unique prefix to indicate system, followed by a number. (Example: CW-1, CW-2, HW-1, etc..). In general, the prefix will match the system abbreviation used on the drawings.
   3. Equipment Identification
      a. Controls: Label magnetic starters and relays on identify connecting or controlled equipment. Label manual operating switches fused disconnect switches and thermal overloads switches which have not been specified as furnished with indexed faceplates as to “connected” or “controlled” equipment. Label automatic controls, control panels, zone valve, pressure electric, electric pressure switches, relays, and starters.
      b. Pumps: Identify booster pumps as to service zones served with tags secured by brass chains. Label base-mounted pumps.

c. Storage Tanks and Heaters: Label tanks as to service. Identify the connecting pipes to each tank.
d. Fans: Label supply and exhaust fans and air handling units as to drawing code number, service and areas of zones served.
e. Fire Dampers and Combinations Fire/Smoke dampers: Identify all fire dampers and combination fire/smoke dampers and their access door by printed stencil secured to access door or a location approved by Architect.
f. Provide labels for concealed mechanical equipment located above ceilings, such as: variable air volume, terminal units, duct coils, circ pumps, in-line fans. Locate label under ceiling at tee grid of lay-in ceiling. Pressure sensitive markers may be used for this application.
g. Provide labels for all concealed isolation valves above ceilings. Locate label under ceiling at tee grid of lay-in ceiling. Pressure sensitive markers may be used for this application.

PART 2 – PRODUCTS

A. MATERIALS
1. Pipe Markers: Utilize either of the following methods:
a. Pressure sensitive markers: Flexible film identification markers and tape, with legend size and color coding per ANSI A13.1.
b. Stenciled markings: Use clear cut stencils and black oil base spray paint. Provide 1” high letters on small pipe sizes and 2” high on larger pipe sizes. Flow arrows shall be at least 6” long.
2. Tags: Aluminum or brass 1½” diameter with edges ground smooth. Evenly spaced and stamp letters and number into the metal surface. Provide brass chain for attachment.
3. Equipment Labels: White plastic laminate with black engraving, or standard brass strips fastened with brass screws. Pressure- sensitive embossed labels (Dymo-type) not acceptable. Provide labels to uniform size commensurate with the size of the equipment to which attached, minimum ½” high letters. Label shall identify equipment terminology to match equipment schedules and plan documentation.
4. Equipment Nameplates: Provide manufacturers equipment nameplate for all equipment. Nameplate shall be clearly visible. Nameplates located in exterior locations shall be protected from fading due to sun and elements. Nameplate shall include the following:
a. Manufacturer Name, product name, model number, and serial number
b. Operating capacity, operating and power characteristics, and essential data
c. Labels of tested compliances
5. Lay-In Ceiling Identification:
a. Self-adhesive type paper or laminate plastic tape. 3/4 inch wide and 1-1/2 inch long with pre-printed identification.
b. Color: White background with black lettering.
c. Label Information: Provide identification of equipment, valve, control device, or similar equipment above lay-in ceiling. Label shall include identification as noted on contract documents, or clear identification of unit above ceiling.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 – GENERAL

A. GENERAL

1. Test and balance shall be contracted directly through the District.

B. SUMMARY – SECTION INCLUDES
1. Adjust and balance Water Mechanical System
2. Adjust and balance Air Mechanical System
3. Adjust and balance Domestic Water Heating Systems (as indicated)
4. Check each piece of operating equipment provided on Div. 23
5. Balancing Report

C. REFERENCED STANDARDS (MINIMUM CRITERIA)
1. Balancing Work: To be done under direct supervision of a registered professional engineer, having an experienced record of not less than five (5) years in the mechanical contracting industry, engaged in testing, balancing, and adjusting of air and hydronic mechanical systems for not less than two (2) years at a time.
2. T&B Contractor shall be contracted direct by the School District.
3. Acceptable Contractors:
   a. Midwest/Colorado Springs Inc.
   b. JPG Engineering
   c. TAB Services
   d. Griffith Eng Svcs.
   e. Jedi Balancing.
   f. Double T
   g. Complete
   h. Lawrence H Finn
   i. Air Right Inc.
   j. Richter Commissioning Group
4. Referenced Standard: Comply with AHSRAE Handbook Chapter on testing, adjusting, and balancing.
5. Warranty: The balancing agency shall provide an AABC National Guarantee Certification or NEBB equivalent. In addition, the balancing agency shall include an extended warranty thought one (1) full heating and cooling season after completion of the test and balance work, during which time the Architect at his discretion, may request a re-check of the setting of any outlet, supply air fan, exhaust fan, etc., as listed in the Balancing Report. The balancing agency shall provide technicians to assist the Architect in making any tests he may require during this period.

D. SUBMITTALS
1. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made, or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
2. Balancing Report: At completion of work submit Balancing Report.
3. Where required for the scope of work for major mechanical equipment replacement, terminal unit replacement, or similar, provide pre-construction balance. Pre-construction balance shall include measurement of existing conditions for use as reference during final balance. Pre-construction balance shall include:
   a. Large Rooftop Air Handling Units

b. Small Rooftop Air Handling Units
c. Make-up Air Units
d. VAV/FPVAV/Fan Coil/Terminal Units
e. Hydronic balancing valves as indicated on drawings.
f. Hydronic heating/cooling pumps.
g. Hydronic heating/cooling coil flow rates.

E. RESTRICTIONS/CRITICAL CRITERIA
   1. General: Check, adjust and balance air and water systems to meet the design performance and tabulate results on acceptable forms. Minimum data to include amperage, voltage input, and thermal heater capacity of each motor, equipment nameplate data, operating speed, pressure drop across each filter bank, pressure rise across each fan and pump, CFM capacity each outlet, zone and fan, and heating or cooling capacity of each coil or element.
   2. Warranty Period Inspection: After eleven (11) months of occupancy, perform a complete report of total system analysis with full report to Architect. Put controls through normal operating cycles (do not change any calibration point).

F. STATUS OF SYSTEMS
   1. Air and water testing and balancing shall not begin until the system to be tested has been cleaned and flushed and is in full working order. Where glycol is used, it shall be installed prior to hydronic balancing.
      a. Coordinate scheduling of work with the general contractor and appropriate subcontractors. Schedule TAB work to coincide with testing and verification of control systems.
      b. Provide written notification (within 24 hours) to the general contractor, engineer, and owner or his/her representative of any component and/or system deficiencies.
   2. Review available plans and specifications for the project and make visual observations during construction to determine that required balancing devices are being installed properly, and access to them is provided.
   3. Before any air balance work is done, systems shall be checked for:
      a. Excessive duct leakage. Excessive duct leakage shall be corrected.
      b. Dirt and debris in ducts and/or air handling units (AHUs).
      c. Filters are installed and changed if they are dirty.
      d. Coil fins are clean and combed where needed.
      e. Verify motor rotation and correct if necessary.
      f. Excessive vibration. Excessive vibration shall be corrected.
      g. Equipment has been lubricated in accordance with manufacturer's recommendations.
      h. Proper operation of automatic control and smoke dampers shall be verified.
      i. Manual control dampers, fire dampers, and air outlet dampers are wide open.
      j. Duct end caps are properly installed, and access doors closed.
      k. Grilles, registers, and diffusers are properly installed.
   4. Before any hydronic balancing work is done, the system shall be checked for:
      a. Proper cleaning and flushing have been completed; glycol installed when specified.
      b. Dirty strainers have been cleaned.
      c. Correct pump rotation has been verified.
      d. Proper control valve installation and operation.
      e. Proper system static pressure to assure a filled system.
      f. Air in system eliminated.
      g. Proper flow meter and check valve installation.
      h. Manual balancing devices, control and shut-off valves are open.
   5. Put heating, ventilating, and air conditioning systems and equipment into full operation and continue operation of same during each working day of testing and balancing.

G. For remodels and additions, TAB shall include the entire system being worked on. TAB of an extended or modified branch only shall not be accepted.

PART 2 – PRODUCTS

A. INSTRUMENTS

1. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards, recommendations, and requirements of NEBB.
2. Calibration histories for each instrument shall be available for examination.

B. REPLACEMENT ELEMENTS
1. Provide replacement sheaves and replacement thermal overload elements which may be required to satisfy the actual job design conditions.

PART 3 – EXECUTION

A. AIR BALANCE
1. Balance air supply, return, and exhaust systems and record air quantities for each air device.
   a. The pilot tube traverse method for determining main duct CFM shall be used and recorded wherever possible; flow hood measurements at registers and diffusers may be totalized for branch duct quantities.
2. Air diffuser pattern shall be set to minimize objectionable drafts and noise.
3. The supply, return, and exhaust fan static pressures shall be set by the balancing firm (and the controls contractor if the systems have fan volume control).
   a. The lowest fan speed resulting in satisfactory system performance shall be determined at full design delivery. Any inlet or outlet fan volume (balancing) dampers shall be in the wide-open position, and one path presenting the greatest resistance to flow shall be fully open and unobstructed.
   b. Fan RPMs shall not be increased by more than 10 percent without prior authorization from the engineer.

4. Provide system static pressure profiles that identify pressure differences across all components of air handling units and built-up systems. Pressure drops shall be individually measured and recorded for intake and exhaust vents, hoods, louvers, manual and auto control dampers, filters, coils, evaporative coolers, fans, etc.
   a. On systems with OSA economizers, pressure drop values shall be recorded for both minimum and 100 percent OSA modes.
5. Building static pressure adjacent to entries shall be measured and recorded. Adjust systems to maintain a positive pressure of 0.05" w.c. where possible. Note any discrepancies.
6. When air balancing is done and manual dampers are set, all test holes shall be plugged, and all manual damper positions shall be marked.

B. HYDRONIC BALANCE
1. Converters: record all steam and/or water inlet and outlet temperatures, pressure drops, and flows.
2. Record inlet and outlet water temperatures of all AHU coils, unit heaters, convectors, finned tube radiation, and other heat release equipment, as well as the corresponding media flows and pressure drops.
3. Boilers: provide data for boiler operating conditions and thermal efficiencies. (Provide a copy of the independent testing agency report if the TAB Contractor does not perform testing.) The TAB Contractor shall measure water side temperatures, pressures, and flow rates if requested by owner and/or boiler testing agency.
4. Chilled water systems: measure and record chilled and condenser inlet and outlet fluid temperatures, evaporator and condenser fluid pressure drops and flows, full-load motor running voltage and amperage, chiller refrigerant pressures and temperatures.

5. DX cooling systems: record condensing unit full and part-load amperages, condenser fan(s) rotation and running amperage(s), high and low side refrigerant pressures, coil inlet and outlet air temperatures at full-load condition. Verify operation of condenser fan and head pressure controls.
6. Hydronic pumps: record flow rates, pressures, running amperage, and full-load amperage at design flow and shutoff conditions. Verify and record impeller size and shutoff head.
7. When all hydronic balancing is done, all balancing valve positions shall be marked, and the locking devices set. Control valve bypass loops (where used) shall be set with the balancing valve to provide equal flow in either mode.

C. ELECTRIC HEAT
1. Record full-load and part-load (when staged) amperage and voltage of all electric heating elements.
2. Verify that electric heat is locked out when the flow rate drops below minimum requirements.

D. SMOKE SYSTEMS
1. Test all smoke management systems per Chapter 4 of the latest version of NFPA 92A.
2. Refer to Section 230900 Controls, for smoke management sequences.
3. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. SYSTEM TOLERANCES
1. Allowable tolerances
   a. Tolerances of adjustment for air handling systems: ± 5 percent for supply systems and ± 10 percent for return and exhaust systems from figures shown on drawings.
   b. Tolerances of adjustment for hydronic systems: ± 10 percent of design conditions shown on drawings.

F. TAB REPORT
1. The report shall include all test and balance data, as well as information on any discrepancy from specifications or performance standards. All discrepancies shall be included in a separate section. As a minimum, the following items shall be included:
   a. Belt and drive sheave information (as installed and as changed), fan nameplate information, motor nameplate information, and amperage and voltage to all motors (in various operating modes where applicable). Also, maximum and minimum RPM settings on VFD units.
   b. Static pressure drops across all components of the air systems. Static pressure profile for each AHU system.
   c. Required and final balanced CFM at each system terminal unit. Include the terminal size, inlet static pressure, temperature, and velocities read to attain the required CFM.
   d. Pump and motor nameplate information, amperage and voltage to all motors, flow and pressure drop across all system terminals, pressure rise across the pump in psi and feet of head, both operating and shut-off, and maximum operating GPM.
   e. Refrigerant system operating amperages, pressures, and temperatures.
   f. Overload protection data for all motors shall be recorded. Starter and/or VFD brand, model, enclosure type, installed overload devices, original ratings and set points (and revised device ratings and set points when applicable) shall be recorded. If the starters (and/or VFDs) were furnished by the mechanical contractor, the overloads shall be verified and changed to the correct size when necessary, and so noted in the report. If the starters were furnished by the electrical contractor, the correct overload device sizes and settings shall be noted in the report and the electrical contractor shall be advised of all discrepancies.

2. A reduced set of drawings (11” x 17”) shall be included in the report with all terminals (VAV boxes, air outlets, inlets, coils, unit heaters, finned tube loops, radiant panel loops, etc.) clearly marked, all equipment designated, and all referenced to the device test reports. The contract drawings may be reduced and used for this purpose if they remain legible. Otherwise, CAD reduced-size drawings shall be obtained from the engineer.
3. The TAB contractor shall submit bound copies of the final TAB report to the owner or his/her representative at least 15 days prior to the mechanical contractor’s request for final inspection. The report shall include all operating data as previously listed, a list of all equipment used in TAB work, and shall be signed by the supervising professional engineer or certified TAB supervisor and certified TAB technician and affixed with his certification seal. Final acceptance of this project will not take place until a satisfactory report is received.

G. FIELD VERIFICATION
1. Upon request of the owner or engineer, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals selected at random. It is understood that the operating mode of the system shall be the same for the read back as it was during balancing, and the number of readings verified will not exceed 10 percent of the total in the report.
2. When deemed necessary by the owner or engineer, the balancing firm shall run temperature, pressure, and/or humidity recordings, and shall be prepared to verify any of the report test results in the presence of the owner and/or engineer when requested.

END OF SECTION

SECTION 23 05 95

DEMONSTRATIONS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Demonstration of operation systems provided under Division 21, 22 and 23.

A. SEQUENCING/SCHEDULING
   1. Conduct demonstrations only after systems have been though start-up procedures, systems are complete and operating, test and balance is complete, and operating and maintenance data are complete.
   2. Demonstrations shall not be included as part of equipment start-up.

B. DEMONSTRATIONS
   1. Instruct the Owner's representative once, in presence of the Architect and Engineer, on the proper operation and maintenance of the mechanical systems. Include seasonal concerns and operations.
   2. Manufacturer's representative shall have a thorough understanding of each particular equipment. The manufacturer's representative for the following equipment shall be present to provide demonstrations: Boilers, Air- or Water-Cooled Water Chiller, Rooftop Units, Air Handling Units, Make-up Air Units, and Automatic Temperature Control Systems.

C. SUBMITTALS:
   1. Instruction Program:
      a. Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructor' names for each training module. Include learning objective and outline for each training module.
   2. Demonstration and Training DVDs:
      a. Submit two copies within seven days of end of each training module.
      b. On each copy, provide an applied label with the following information:
         1. Name of Project.
         2. Name and address of photographer.
         3. Name of Architect.
         4. Name of Contractor.
         5. Date of recording.

B. COORDINATION:
   1. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
   2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
   3. Coordinate content of training modules with content of approved emergency, operation, and maintenance modules. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect and Engineer.

PART 2 – PRODUCTS

A. PROGRAM STRUCTURE:

1. Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
    a. Boiler(s) and boiler systems including boilers, pumps, and hydronic accessories (minimum 2 hours).
    b. Package rooftop units (minimum 2 hours)
    c. Make-up air systems including kitchen make-up air systems (minimum 2 hours)
    d. Package, custom, and large air handling units (minimum 2 hours)
    e. Domestic water heating systems including water heater, circulation pump(s), storage tanks, controls, and accessories (minimum 2 hours)
    f. HVAC instrumentation and controls; building automation systems (minimum 8 hours).

B. TRAINING MODULES:
1. The operating and maintenance manual shall constitute the textbook for instruction.
2. Review contents of manual in detail to explain all aspects of operations and maintenance.
3. Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
    a. Basis of System Design, Operational Requirements, and Criteria Include the following:
        1. System, subsystem, and equipment descriptions.
        2. Performance and design criteria if Contractor are delegated design responsibility.
        3. Operating standards
        4. Regulatory requirements
        5. Equipment function
        6. Operating characteristics
        7. Limiting conditions
        8. Performance curves.
    b. Documentation: Review the following items in detail:
        1. Emergency manuals
        2. Operations manuals
        3. Maintenance manuals
        4. Project record documents
        5. Identification systems
        6. Warranties and bonds
        7. Maintenance service agreements and similar continuing commitments.
    c. Emergencies: Include the following as applicable:
        1. Instruction on meaning of warnings, trouble indications, and error messages.
        2. Instructions on stopping.
        3. Shutdown instructions for each type of emergency.
        4. Operating instructions for conditions outside of normal operating limits.
        5. Special operating instructions and procedures.
    d. Operations: Include the following, as applicable:
        1. Startup procedures.
        2. Routine and normal operating instructions.
        3. Regulation and control procedures.
        4. Control sequences.
        5. Safety procedures.
        6. Instructions on stopping.
        7. Normal shutdown instructions.
        8. Operating procedures for emergencies.
        9. Operating procedures for system, sub-system, or equipment failure.
        10. Seasonal and weekend operating instructions.

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11. Special operating instructions and procedures.

e. Adjustments: Include the following:
    1. Alignments
    2. Checking adjustments
    3. Noise and vibration adjustments
    4. Economy and efficiency adjustments.

f. Troubleshooting: Include the following:
    1. Diagnostic instructions
    2. Test and inspection procedures.

g. Maintenance: Include the following
    1. Inspection procedures
    2. Types of cleaning agents to be used and methods of cleaning.
    3. List of cleaning agents and methods of cleaning detrimental to product
    4. Procedures for routine cleaning
    5. Procedures for preventative maintenance
    6. Instruction on use of special tools.

h. Repairs: Include the following:
    1. Diagnosis instructions
    2. Repair instructions
    3. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    4. Instructions for identifying parts and components.
    5. Review of spare parts needed for operation and maintenance.

PART 3 – EXECUTION

A. PREPARATION
    1. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. INSTRUCTION:
    1. Facilitator:
        a. Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and locations.

C. DEMONSTRATION AND TRAINING DVDS:
    1. General:
        a. Engage a qualified photographer to record demonstration and training DVDs. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At the beginning of each training module, record each chart containing learning objective and lesson outline.

END OF SECTION

SECTION 23 05 97

SYSTEMS STARTING

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Start-up of operating systems provided under Divisions 21, 22 and 23.

B. START-UP AND TESTING
   1. Manufacturer's Representative: Present for starting of following systems:
      a. Boilers
      b. Rooftop Units
      c. Condensing Units
      d. Domestic Water Heater
      e. Chillers
      f. Air Handling Units (not including fan coil units, cabinet unit heaters, exhaust fans, and similar unitary equipment)
      g. Major equipment as required by District during design for specific locations such as make-up air units, energy recovery units, etc.
   2. Ensure that control systems are fully operational in automatic mode.
   3. On verification of the installation the manufacturer's representative shall report in writing to the Architect/Engineer. Report shall include any installation errors, or other fault in the system that would affect the performance of the system.
   4. Notify Architect at least five (5) days in advance of the start-up of mechanical systems.
   5. Conduct start-up and start-up testing in presence of Architect and Engineer. See applicable sections of Divisions 21, 22 and 23 for specific requirements.
   6. Complete tests required by code authorities including smoke detection, fire protection and health codes.
   7. Ensure that control systems are full operational in automatic mode.
   8. Boilers and Gas Fired Water Heaters – Supervision, Testing and Adjusting: Boilers representative shall provide a factory trained and factory authorized service personnel to perform the following:
      a. Start-up equipment and check out.
      b. Adjust firing and performance test. Testing and report shall be ASME short from for low and full load conditions. The equipment and instruments required to perform the tests must meet the approval of Owner.
      c. Burner shall be adjusted to not less than 9 to 2-1/2% Co2 at 0% CO (CO shall not exceed 200 PPM) and 4.5% O2 on gas firing. Flue gas analysis shall be made with approve type testing instruments. Flue temperature shall not exceed 450°F.
      d. The date of the above test and name of firm or individual making this test (Note: The Owner shall be notified 3 or 4 days prior to test) shall be submitted in triplicate, together with test report submitted in triplicate to the Owner. Tests to be run at a mutually accepted date when weather is such as to provide a heading load sufficient to sustain high fire operation. The test shall include but not be limited to the gas burner manifold in inches W.C., meter pressure at outlet CFH-gas, input MBH, stack temperature at flue outlet, CO2%, O2%, CO% and combustion efficiency %.
      e. Above combustion test shall be witnessed and certified by a Colorado State Registered Mechanical Engineer hired by the Contractor.
   9. Chiller and Rooftop Units: Chiller and rooftop unit manufacturer shall provide start-up and testing.
      a. Submittals

1. Engineer's approval is required for all Start-up/ Field Tests (SU/FT) reports which will be used by the manufacturer's representative for each item of equipment to be started. This report is to be included with the respective equipment submittals.

b. Field Tests and Start-up Coordination:
   1. Prior to the SU/FT services being performed, the Contractor shall verify that the systems have been installed properly and all utility services (water, electrical, gas, etc.) have been connected and are operational for all equipment.
   2. Contractor shall notify the Engineer and manufacturer's Representative seven (7) days before the SU/FT services are to be conducted. Contractor shall also coordinate with electric, control, mechanical and/or sheet metal contractors such that a qualified representative from each trade is available during SU/FT period.

c. Start-up and Field Tests:
   1. Completed start-up reports showing all field tests performed to prove compliance with the specified performance criteria shall be submitted to the engineer of record, upon completion and testing of the system.
   2. The following information, as a minimum, shall be included in the SU/FT reports, along with any additional testing procedures required and/or recommended by the manufacturer.
      i. Job Information Sheet
      ii. Job Location and address
      iii. Company name, contact, the installing contractor, engineer, and manufacturer's representative(s).
      iv. Manufacturers Unit Nameplate Data & Jobsite Tagging
      v. Pre-Start checklist procedure, to include but not limited to, the following items:
      vi. Confirm all fans operating and rotating correctly.
      vii. Refrigerant piping
      viii. All set points and setting for field adjustment of controls, control boards, safeties.
      ix. Check all field-installed electrical connections for accuracy.
      x. Inspect all control panel components, tighten any loose connections.
      xi. Check compressor crankcase oil levels.
      xii. Check the supply and exhaust fans for proper belt tension and sufficient lubrication. If necessary, readjust belt tension and lubrication fans.
      xiii. Check supply and exhaust fans optional spring isolators for proper adjustment.
      xiv. Check that power supply balance is within manufacturers recommended guidelines.
      xv. Remove all shipping blocks and brackets from unit.

d. Test/Start-up Log – Taken at 3 intervals, 30 minutes apart:
   1. Fans (supply, Condenser, Exhaust): Amp draw.
   2. Compressors: Voltage at compressor terminals, Voltage imbalance, Amp draw, % load.
   3. Refrigerant & HVAC Operating Conditions: Ambient temperature, evaporator entering and discharge temperature (DB&WB) on DX system, discharge and suction pressures, liquid and suction line temperatures, superheat, sub cooling, sight glass condition, % load.
   4. Safeties: List type and settings.

10. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, clean permanent pipeline strainers and filters, replace air filters, properly adjust valve, and pump packing's, adjust belt tensions, secure drive guards in place, check lubrication and replenish if required.
11. If systems are not to continue in use following the start-up procedures, take steps to insure against accidental operation or operation by unauthorized personnel.

C. RESTRICTIONS/CRITICAL CRITERIA
1. Inspection: Inspect preceding work to ensure that:
a. Electrical:
1. Temporary services are disconnected, and permanent utility services are capable of full load.
2. Connections in main switchgear and subpanels are tight.
3. Necessary tests and check meter readings have been made.
4. Wiring to motors and controls required for operational smoke and fire protection code demonstrations are complete.
b. Mechanical:
1. Specified tests on piping, ductwork and related systems have been made.
2. Operational and performance tests have been made.
3. Each piece of equipment comprising a part of the system has been checked for proper lubrication, drive rotation, belt tension, proper control sequence, and other conditions which may cause damage to equipment or endanger personnel.

END OF SECTION

SECTION 23 07 00

MECHANICAL INSULATION

PART 1 – GENERAL

A. SUMMARY – SECTIONS INCLUDED
   1. Piping Insulation including Valves and Fittings
   2. Equipment Insulation
   3. Duct Insulation

B. REFERENCED STANDARDS
   1. Requirements of Regulatory Agencies:
      a. Fire hazard classification: Insulation shall have a composite (insulation, jacket or facing, and adhesive to secure jacket or facing) fire hazard rating as tested by ASTM E-84, NFPA 225, or UL 723 not to exceed 25 flame spread and 50 smoke developed. Materials labeled accordingly.
      b. Energy conservation: Insulation and thickness shall be in accordance with requirements set forth in the International Energy Conservation Standard Code (IECC). In the event of a conflict between the thicknesses listed in this document and the IECC the most stringent requirements shall apply.

C. SUBMITTALS
   1. Product data: Submit for insulation, adhesive materials, and installation instructions.

D. CRITICAL CRITERIA/RESTRICTIONS
   1. Installation of Pipe Insulation
      a. Seal vapor barriers and run continuous throughout the following insulation systems: heating water, chilled water, and refrigerant piping.
      b. Insulate fittings and valves. Do not insulate hot water heating pipe within radiation enclosures, unions, flanges, strainers, flexible connections, and expansion joints. Terminate insulation neatly with insulating and finish cement trowelled on bevel.
      c. Finish insulation neatly at hangers, supports and other protrusions. Locate insulation over cover seams in least visible locations.
      d. Provide thermal hanger shields with galvanized metal saddles in the following locations:
         1. For piping fitted with VB jacket, at all hangers.
         2. For piping fitted without VB jacket, at all hangers carrying piping 1¼” and larger. For smaller pipe, insulation may be applied over hanger.
         3. For piping resting on trapeze hangers.
      e. Exposed locations: When pipe insulation is exposed with-in a finished room, provide a 22-gauge sheet metal cover. Sheet metal cover shall extend from floor slab to ceiling. When room does not have a ceiling the sheet metal cover shall terminate 12 feet above floor slab. Sheet metal cover not required in mechanical equipment rooms.
      f. Exterior: Cover with specified aluminum jacket secured with aluminum bands 12” on center. Seal joints with waterproof plastic cement.
   2. Installation of Equipment Insulation
      a. Low Temperature, 450°F to -20°F: Glass fiber insulation board or wrap: cut or mitered to fit the shape of the equipment. Secure with ½” x 0.020” galvanized steel bands or 16-gauge galvanized wire 12” on center. Weld pins or stick clips with washer may be used for flat surfaces. Space 18” apart. Stagger joints where possible and fill voids with vapor barrier mastic. Finish with eight (8) ounce canvas and fire-retardant vapor barrier mastic. Irregular surfaces may be insulated with insulating cement and finish in the same manner.

3. Installation of Duct Liner
    a. Duct Liner: minimum lining thickness per duct liner schedule. All duct liner shall be Type 2, except: Low pressure ductwork downstream of duct coils, acoustic elbows which shall be Type 1. Flame spread 25, smoke developed 50 per NFPA 90A. Install duct liner in accordance with referenced SMACNA standards for duct with maximum velocity of 4,000 FPM. Provide metal nosing at leading edges of all ductwork. Adhesively secured fasteners not allowed. Except as noted below, all rectangular supply return air and transfer air duct work shall be internally lined.
4. Installation of External Duct Insulation
    a. Concealed Locations
        1. Round Duct: Insulate with 1 PCF duct wrap.
        2. Rectangular Duct Insulate with 3 PCF external duct insulation.
    b. Exposed Locations Rectangular Duct: Insulation shall be fastened to duct with mechanical fasteners.
    c. Insulate round sheet metal ductwork. Omit external duct wrap for exposed supply air duct in Gymnasium.
    d. OA intake systems: Insulate plenums and ductwork with glass fiber external duct insulation.
5. Pipe insulation Schedule.
        a. Thicknesses: Insulate the following pipe systems with thickness indicated.

INSULATION THICKNESS IN INCHES FOR PIPE SIZES

Fluid Type and Operating Temperature Range	Insulation Conductivity		Nominal Pipe or Tube Size (Inches)				
	Conductivity Btu · in/(h · ft^2 · °F	Mean Rating Temperature, °F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≤8
LPS/LPC (251 – 350)	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
LPC/LPC (201 – 250)	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
HS/HR (141 – 200)	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
HS/HR (105 – 140)	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
CHS/CHR (40 – 60)	0.21 – 0.27	75	1.0	1.0	1.0	1.0	1.0
CHS/CHR (< 40)	0.20 – 0.26	50	1.0	1.0	1.0	1.0	1.5

    b. Chilled water: Insulate complete as follows:
        a. Above grade: Insulate complete with fiberglass insulation.
        b. Below grade: Insulate complete with rigid closed cell pipe insulation. Adjust thickness to match performance of fiberglass pipe insulation.
        c. Exterior: Insulation with rigid closed cell pipe insulation. Insulation shall be nominal 2½" thick.
    c. Heating water: Insulate complete with fiberglass insulation, except interconnected radiation piping in the wall.
    d. LP steam and condensate: Insulate complete with fiberglass insulation.

e. Refrigerant liquid and suction lines: Insulate complete with fiberglass insulation or flexible elastomeric cellular insulation.
f. Insulation of piping exposed to freezing with heat tracer.

a.

6. Duct Work Insulation Schedule

LINER AND DUCT WRAP THICKNESS FOR DUCT LOCATION

Duct System	**Indoors (exposed or concealed) where subject to ambient temperatures similar to room conditions >15°F difference between duct and plenum temperature.**	**Where subject to ambient temperatures similar to outdoor temperatures**
Supply and Return Air (Lined)	1-1/2" – 2" (R-6 minimum installed)	2-1/2" – 3" (R-12 minimum installed)
Supply and Return Air (Wrapped)	2" – 2-1/2" (R-6 minimum installed)	3" – 3-1/2" (R-12 minimum installed)
Fresh Air/Outside Air (Lined)	Not Allowed	Not Allowed
Fresh Air/Outside Air (Wrapped)	2" – 2-1/2" (R-6 minimum installed)	3" – 3-1/2" (R-12 minimum installed)
Exhaust Air	Not Required	Not Required
Special Exhaust Systems	Not Required unless dictated by system requirements	Not Required unless dictated by system requirements

7. Equipment Insulation Schedule

a. Chilled Water Pump: Pump shall be covered with minimum 2-inch foamed glass. Insulation shall be boxed around pump volute, bearings, and portion of pump below volute. Cover with mastic reinforced with white starch sized glass fabric and finish with white, brushed smooth mastic which conceals the fabric. Install to permit servicing.

PART 2 – PRODUCTS

A. ACCEPTABLE MANUFACTURERS
1. Mineral Fiber (Glass Fiber) Insulation:
   a. Manville
   b. Certainteed Manson
   c. Ownes Corning
   d. Knauf
2. Pipe Insulated Fitting Covers:
   a. Manville
   b. Cerainteed Manson
   c. Owens Corning
   d. Ceel-Co
3. Flexible Closed Cell Elastomeric Insulation:
   a. IMCOA Pipe Insulation
   b. Armstrong World Industries
   c. Armaflex

d. Armacell
4. Fire Retardant Vapor Barrier Mastic: Benjamin Foster
5. Insulate and Finishing Cement:
   a. Schuller International, Inc.
   b. Lamtec
   c. Alpha Associates
   d. Approved Substitute
6. Duct Liner:
   a. Johns Manville
   b. Certainteed
   c. Knauf
   d. Owens Corning
7. Rigid Closed Cell Insulation:
   a. Pittsburgh Corning Foamed Glass
   b. Owens Corning
   c. Certainteed
   d. Knauff
   e. Approved Substitute
8. Mastic Used In Conjunction With Rigid Closed Cell Insulation:
   a. Pittsburgh Corning Pittwrap or Pittwrap SS II
   b. Compatible with insulation system
   c. Approved Substitute

B. MATERIALS
1. Pipe Insulation
   a. Above grade, interior, -20°F to +450°F: Glass fiber pipe insulation ASTM C 547 Type 1. Maximum k/inch: 0.25 at 75°F. All service jacket with self-sealing laps.
   b. Above grade, interior: -40°F to +210°F: Flexible closed cell elastomeric insulation ASTM C 534 Type 1 and ASTM D 1056. Maximum k/inch: 0.28 at 75°F. Butt seal joints with contact adhesive.
   c. Above grade, exterior: Same as interior except cover with 0.016 smooth aluminum jacket. Seal all joints and seams with silicon sealant.
   d. Below grade, 2” and under, -40°F to +210°F: Flexible closed cell elastomeric insulation. ASTM C 534 Type 1 and ASTM D 1056. Maximum k/inch: 0.28 at 75°F. Butt seal joints with contact adhesive.
   e. Below grade, over 2”: Non-flammable waterproof mineral powder.
   f. Below Grade: 170°F and below Rigid Closed cell ASTM C 552 with Pittwrap jacked. Maximum k/inch: 0.35 at 75°F. Average density 8.5 LBS per cubic foot. Compressive strength 100 PSI.
2. Fittings and Valves Insulation:
   a. For glass fiber insulation: Pre-molded 30 mil PVC cover with fiberglass inserts. Seal at end and throat on cold systems.
3. Vapor Barrier Mastic Coatings: Perm rating not more than 0.25 when tested in accordance with ASTM E 96, Procedure a Fire Retardant.
4. Adhesives, Sealers, Facings, and Vapor Barrier Coatings: Compatible with materials to which applied, and shall not corrode, soften, or otherwise attack the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coating recommended by the approved manufactures and insulation materials.
5. Chemical for Treating Paper: Non- Soluble.
6. Equipment Insulation:
   a. Equipment Insulation, -20°F to 450°F.

b. Glass Fiber Insulation Board, ASTM C 612, Class 2. Maximum k/inch: 0.23 at 75°F. Density: 6 lbs./cu.ft. Foil-scrim-kraft-facing.
c. Foamed Glass Insulation Board, ASTM C 552. Maximum k/inch: 0.35 at 75°F. Average density 8.5 lbs. per cubic foot. Compressive strength 100 PSI.

7. Ductwork Insulation
   a. Type 1 duct liner insulation shall be black coated surface resilient glass fiber with non-combustible coating. Liner shall have a k factor of 0.25 or less at 75°F mean temperature. Noise reduction coefficient shall not be less than 0.70 for 1" thickness and 1.00 for 2" thickness, based upon type "A" mounting. All fasteners shall be welded type.
   b. Type 2 duct liner insulation shall be black coated surface resilient glass fiber with non-combustible coating. Liner shall have k factor of 0.24 or less at 75°F mean temperature. Noise reduction coefficient shall not be less than 0.70 for 1" thickness based upon ASTM C 423-81 and ASTM E 795 type "A" mounting. All fasteners shall be welded type.
   c. Exterior of duct- wrap: Glass fiber blanket duct wrap, ASTM C 553 Type 1, Class B3. Maximum k/inch: 0.23 at 75°F. Three-pound (3 lbs.) density. Foil-scrim-kraft facing.
   d. Exterior of duct – wrap: Glass fiber blanket duct wrap, ASTM C 553, Type 1, Class B3. Maximum k/inch: 0.26 at 75°F. One pound (1 lb.) density. Foil-scrim kraft facing.

END OF SECTION

SECTION 23 08 10

VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Variable Frequency Drives to be furnished by Mechanical Contractor and installed by Electrical Contractor. The data listed below are the minimum VFD requirements.

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ANSI/NFPA 70 – National Electrical Code
   2. UL 508 – UL Standard for Safety Industrial Control Equipment
   3. UL 508C – UL Standard for Safety Power Conversion Equipment
   4. NEMA ICS 7.1

C. SUBMITTALS
   1. Shop Drawings and Product Data:
   2. Variable Frequency Drives
      a. Operating and Maintenance Data:
      b. Variable Frequency Drives

D. RESTRICTIONS/ CRITICAL CRITERIA
   1. Adjustable frequency NEMA 1 drive package shall consist of circuit breaker disconnect, line reactor, EMI/RFI filter, 2 contactor bypass, 120 V control transformer, control circuit terminal for digital and analog field wiring. AC Line fuses do not meet specification.
   2. Drive door shall have mounted and wired, Hand-Off-Auto Switch, Manual Speed Potentiometer and AFC-Off-Bypass Switch. Manual speed bypass shall not be electronic type integrated into VFD panel.
   3. Entire drive package shall be UL508C listed as coordinated with NEMA ICS 7.1. Refer Section 23 00 04 for motors.
   4. Enclosure and heat sink fans shall be accessible from the front and not require the removal of the AC drive power converter for fan replacement.
   5. Speed range shall be from a minimum of 1.0 Hz to a maximum of 720 Hz.
   6. Environmental Ratings: AC drive shall be designed to operate in an ambient temperature from -10° C to 40° C. AC Drives and Type 3R enclosure shall be designed to operate -10° C to 50° C and in full sunlight. Maximum relative humidity shall be 95%, non- condensing. The AC Drive shall be derated per drive manufactures specifications for altitudes about 3,300 feet.
   7. Ratings: The AC Drive shall operate from an input frequency range of 60 Hz (+) 5%. The efficiency of the AC Drive at 100% speed and load shall not be less than 97%. The displacement power factor shall not be less than 0.98 lagging under any load or speed condition.
   8. Protection: Upon power up, the AC Drive shall automatically test for valid operation of memory, loss of analog reference input, loss of communication, power supply, control power and pre-charge circuit. Short circuit coordination per UL 508C and NEMA ICS 7.1. Programmable ride-through function to allow logic to maintain control for a minimum of one-second (60 cycles). For fault conditions other than ground fault, short, circuit, internal fault or short circuit, an auto restart function will provide up to 6 programed restarts. Time delay between restarts shall be 60 seconds. Drive to have UL 508C listed overload protection and meet IEC 60947.

9. Adjustments: AC Drive to be factory programed to operate all specified optional devices. Acceleration and deceleration ramp to be adjustable from 0.05 to 999.9 seconds. Maintain constant volts/Hz ratio during acceleration.
10. Keypad display interface.
11. Operator Controls: 24V dc control power. Combination enclosure with dedicated operator controls. H-O-A, Manual Speed Potentiometer, AFC-Off Bypass switch.
    a. Bypass shall be manual type bypass, electronic bypass not acceptable.
12. Harmonic Mitigation: AC Drive shall include a line reactor mounted inside the drive enclosure to reduce power system harmonics and provide quality power system harmonics and power quality protection for the drive.

E. Coordinate temperature control requirements with controls 23 09 00 for interface with building automation system.
F. Demonstration: Instruct the Owner's personnel in accordance with Section 23 05 95. Factory trained service technician to supervise start-up each variable frequency drive.

PART 2 – PRODCUTS

A. VARIABLE FREQUENCY DRIVES
    1. Acceptable Manufactures:
        a. ABB
        b. Danfos
        c. Graham
        d. Magnetek
        e. Mitsubishi (District preferred)
        f. Reliance
        g. Square D
        h. Yaskawa

END OF SECTION

SECTION 23 09 00

BUILDING MANAGEMENT AND AUTOMATIC TEMPERATURE CONTROL SYSTEMS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. The building Management and Automatic Temperature Control System shall be complete in all respects, including equipment, labor, materials, and services.
   2. The General Provisions of the Contract, including the General Conditions of Supplementary General Conditions, apply to the work specified in this Section.
   3. Certification: At the completion of the project, the Control Contractor shall verify in writing that the control system has been fully exercised through every mode of operation and that the installed system performs exactly as specified in the sequence of operation. The Engineer will not conduct a final inspection of this project until receipt of this certification. Certification shall include as a minimum, a printout of all points of control with set point values and current operating status.

B. BID REQUIREMENTS
   1. The Temperature Control shall be bid to the Owner and assigned to the Mechanical Contractor.

C. SUBMITTALS
   1. Product Data:
      a. Shop Drawings: Show wiring diagrams, auto valve schedule, piping diagrams for all equipment arrangement in panel fronts, bill of materials for all devices, written descriptions of sequence, temperature control diagram, and control valve schedule.
      b. Product Data: Include for all devices; show terminal/ port labels, internal switching, etc., as required to enable complete understanding of the function of the device.
   2. Operating and Maintenance Data:
      a. BMS/ATC systems

D. RESTRICTIONS/ CRITICAL CRITERIA
   1. All electrical work performed in the installation of the BAS/ATC system as described in this specification shall be per the National Electrical Code (NEC) and per applicable start and local codes. Where exposed, conduit shall be parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than ½" trade size be allowed. Where conductors are concealed (tenant spaces), cable rated for use in return air plenums shall be used.
   2. Acceptance Procedure: Upon completion of the calibration, contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Contractor shall be responsible for generating all software and entering all database necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Owner's Representative or Engineer shall be performed. Final acceptance and project completion shall not be considered until verification of control work is demonstrated to District controls manager. Demonstration shall include verification of specific equipment application and sequence, delivery of as-build control diagrams, sequences of operation, and equipment O&M's. Punch list items as identified by the District and Consulting engineer shall be marked as complete and verified prior to acceptance.
   3. Sequence of Controls
   4. Sequence of Controls to be determined by Consulting Engineer.
   5. All controls components shall be specified to be provided by the temperature controls contractor and factory installed. Include specific installation requirements in individual

specification sections as applicable. Packaged unit controls are not acceptable unless approved by the District Project Manager and District Controls Specialist. BACNET controllers shall be limited to those approved by the District.

E. DEMONSTRATION AND TRAINING:
   1. The Contractor shall provide a minimum of 16 hours of training in 4-hour blocks one day per week on system operations and provide control demonstration time at the job site for the Owner's personnel.
   2. This Contractor shall provide at least 4 hours in one session of classroom training at times and location as directed by the Owner. The training shall focus on design, operation, and maintenance procedures of the products installed and shall cover:
      a. Hardware configuration, including PC boards, switches, communication and point wiring, and location of all sensors and control devices.
      b. Hardware maintenance, calibration, troubleshooting, diagnostics, and repair instructions.
      c. Operation of central workstation, including logging on and off, interrogating the system, producing reports, acknowledging alarms, overriding computer control, changing firmware and software parameters, and generating and linking graphic screens.
      d. The operational sequence of each system, including normal and abnormal operating modes, operating control strategies, and operator actions required to reset or monitor the system.
      e. Programming using the editor, program design, syntax, and loading of custom control software.
      f. Recovery procedures from power failures.
      g. Alarm formats.
      h. Maintaining software and programming backups.
   3. The instructor(s) for the above sessions shall be employee(s) of the Control Contractor whose primary function is customer training and applications support.
   4. A minimum of two copies of the most current control drawings shall be provided to the District before the training begins. These shall be in addition to the drawings to be provided under Part 1 Shop Drawing requirements, if the O&M Manuals have not been turned in to the Architect before the time of the training.
   5. The training may be phased. The Owner may elect to conduct training and demonstration in two- to four-hour sessions over the life of the warranty period. All instructional material shall be available to each employee at each training session up to a maximum of ten (10) individuals.
   6. All demonstration and training sessions shall be coordinated with the CCSD Controls Application Engineer.

PART 2 – PRODUCTS AND SYSTEMS

A. MANUFACTURERS
   1. The specified systems are based on a Delta system by Setpoint Systems Corporation. Alternate listed manufacture may submit a bid based on this specification as the minimum standards. Alternate manufacturer’s operator interface, software, reporting capabilities, sequence of operation and points list shall be equal to or in excess of this specification.

B. GENERAL
   1. The Building Automation System shall include but not be limited to the following components.
      a. The Operator interface shall consist of hardware and software that allows full user monitoring and adjustment of system parameters.

b. System Application Controllers shall manage the Energy and Building Management capabilities of the automation system as well as facilitate remote communications and central monitoring.
c. Application Specific Controllers shall provide distributed, pre-engineered control, specific to the mechanical equipment specified.
d. Custom Application Controllers with distributed, custom programming capability shall provide control for nonstandard control sequences.
e. The Data Communications capability shall allow data to be shared between the carious controllers in the architecture.
f. The system software shall include system software for global application functions, application software for distributed controllers, and operator interface software.
g. End devices such as sensors, actuators, dampers, and relays.

2. The failure of any single component shall not interrupt the control strategies of other operational devices. System expansion shall be through the addition of end devise, controllers and other devices described in this specification.
3. The contractor will provide factory software upgrades to the Owner at no charge, for a period of 5 years after system acceptance.

C. OPERATOR INTERFACE
1. An interface shall be provided to allow the building operator to view and acknowledge alarms, access/edit system database information, view system displays and reports, and customize the system as described in this specification. The contractor shall provide any software and hardware required to accomplish the operator interface as specified at the school.

D. SYSTEM APPLICATION CONTROLLERS
1. The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor-based System Application Controllers to manage the global strategies described in application software section.
2. The controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:
a. Assume a predetermined failure mode.
b. Emit an alarm.
c. Display card failure identification.

E. APPLICATION SPECIFIC CONTROLLERS
1. Application Specific Controllers shall be stand-alone, microprocessor based Direct Digital Controllers with sufficient memory to manage its operating system, database and programming requirements.
2. The Application Specific Controller shall be pre-programmed, tested, and factory mounted on the mechanical equipment to ensure reliability. Where factory mounting is not possible, the controllers shall be factory programmed and tested prior to shipment on the job site. The controllers shall be clearly labeled as to controller type, where it is to be installed, and software address (if applicable). The controller shall be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.
3. The DDC Unitary, Application Specific, and Network Controller shall be configured such that the Portable Operatory Interface can be plugged directly into it or within sight for programming, editing and other operator functions.

F. INPUT/OUTPUT INTERFACE
1. Hardwired inputs and outputs may tie into the system through System Application, Custom Application, or Application Specific Controllers. Slave devices are also acceptable. Any

critical points requiring immediate reaction shall be tied directly into the controller hosting the control software algorithm for the critical function.

2. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of 12MA at 12 VDC to be compatible with commonly available control devices. All status points shown on the point list shall be positive proof differential pressure or current sensing binary switches.
3. Analog inputs shall allow the monitoring of low voltage, current, or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
4. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices. Where specified in the sequence of operations or indicated on the points list, binary outputs shall have 3-position (on/off/auto) override switches, status lights and shall be selectable for either normally open or normally closed position.
5. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 milliampere signal as required to provide proper control of the output device.
6. System architecture shall allow for point expansion in one of the following ways:
    a. The addition of input/output cards to an existing System Application Controller.
    b. The addition of unitary or application specific controller.
    c. 10% expansion capacity for all point types in all DDC panels.

G. TEMPERATURE SENSORS:
1. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor as dictated by the requirements of this specification.
2. Accuracies shall be +/- 1 degree F for standard application where high accuracy is required, accuracies shall be +/- 2 degrees F.

H. DIFFERENTIAL PRESSURE SWITCHES:
1. Differential Pressure Switches shall be furnished as indicted for status purposes in air and water applications. Provide single pole double throw switch with fully adjustable differential pressure settings.

I. CONTROL THERMOSTATS
1. High Limit Thermostats: High limit thermostats shall be manual reset type set at 120* F.
2. Low Limit Thermostats:
    a. Safety low limit thermostats shall be vapor pressure type with a 20-foot minimum element. Element shall respond to the lowest temperature sensed by any one-foot section.

J. CONTROL VALVES:
1. The automatic control valve shall be sized by the Controls Contractor for the appropriate pressure drop specified by the A/E to ensure proper throttling performance at all system loads.
2. Close off (differential) Pressure Rating: valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
    a. Water Valves:
        1. Two-way: 150 percent of total system (pump or building domestic water pressure) head.
        2. Three-way: 300 percent of pressure differential between ports A and B at design flow or 100 percent of total system (pump) head.
3. Water Valves

a. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service, except where stated otherwise.
b. Sizing criteria
    1. Two-position service: line size.
    2. Two-way modulating service: pressure drop across the valve in a wide-open position, with full flow through the valve, shall be equal to 50 percent of the available pressure differential between the mains, with a minimum of four (4) psi.
    3. Three-way modulating service: pressure drop across the valve in a wide-open position, with full flow through the valve, shall be equal to twice the pressure drop through the heat exchanger (load), with a three (3) psi minimum.
c. Construction
    1. Valves ½" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon or ring packing, and stainless-steel stems. Two-way valves to have replaceable composition disc.
    2. Characterized ball valves may be utilized in lieu of globe valves. Ball valves shall be bronze body or cast brass ANSI Class 250, with stainless steel or stainless steel coated bronze full port ball, and stainless-steel stems. Valve characterized for uniform modulation of valve through entire control range.
    3. 2-½" valves and larger shall be cast iron ANSI Class 125 with guided plug, stainless steel stems and Teflon or ring packing.
d. Water valves shall fail normally open or closed as scheduled on plans or as follows:
    1. HW zone valves - normally open.
    2. Heating coils in air handlers - normally open.
    3. Chilled water control valves - normally closed.
    4. Other applications - as scheduled or as required by sequence of operation.
e. Butterfly valves: modulating, three-way valves, or two-position valves 4" and larger may be tight closing butterfly valves. Full-lug type, 250 psi WOG, extended neck, cast iron body, aluminum/bronze disk, stainless steel shaft, field replaceable cartridge design, EPDM seat and seal with integral actuator. The modulating, three-way valve substitute shall consist of linked butterfly valves with a factory-installed linkage. Modulating valves shall be sized for three (3) psi pressure drop.
f. Evaporative cooler drain and fill valves
    1. Coordinate with evaporative cooler manufacture for additional requirements for the evaporative cooler package. Drain/fill valve assemblies may be specified with equipment in lieu of by temperature control contractor. TC shall control drain/fill assembly.
    2. Bronze, full-port, two-piece body design; chrome-plated, solid bronze ball with Teflon seats, stem packing shall be adjustable for wear with adjusting screw, 150 WSP, 600 WOG.
    3. Bronze valve material composition shall meet ASTM B62.
    4. Provide valve complete with actuator, mounting bracket, and all required linkage.
    5. Valve normal position shall be as shown on the drawings.
g. For systems with glycol solutions, provide documentation that the valve components in contact with the fluid are compatible with glycol.

K. AUTOMATIC DAMPERS
1. All dampers not specified with equipment in other sections of the specifications shall be furnished by the Temperature Control Contractor and shall be single or multiple blade type as required.
2. All damper frames are to be constructed of #13 Gauge G90 galvanized sheet metal, roll formed into channels and welded for maximum strength and shall have flanges for duct mounting.

3. All blades shall be fabricated from single #16-gauge G90 galvanized sheet metal. Blade pins shall be steel, zinc plated, and chromate treated to provide no-slip pivoting when a damper is used as a single module or is interconnected with others. Blades shall be suitable for high velocity performance.
4. Dampers used for outside, return, or exhaust air, and those used for zone mixing dampers shall be provided with seals to provide tight shut off along all edges of all blades; tight closing and low leakage damper of less than 4.5 cfm/ft. at 1" static pressure. Bearings shall be oil impregnated to provide constant lubrication.
5. Blade edge seals and top and bottom channel seals shall be easily replaced if they are damaged. An internal stop shall be provided on all dampers to prevent over-rotation in the closed position.

L. ACTUATORS:
1. Actuators shall be electronic, spring return, low voltage (24VAC) and properly selected for the valve body, damper frame and service.
2. Actuators shall be fully proportioning and be spring returns for normally open operation as called out in the sequence of operations.

M. OPERATOR INTERFACE SOFTWARE
1. System Security:
   a. User access shall be secured using individual security passwords for a minimum of eight users.
   b. User log-on/log-off attempts shall be recorded.
   c. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
2. Alarms:
   a. The building Automation System shall provide audio, visual, contact closure and remote telephone annunciation for:
      1. Remote equipment failure
      2. Equipment run time.
      3. Number of start/stops
      4. Program failure
      5. Card failure
      6. Sensor failure
   b. An after-hours alarm processing function shall transfer the alarm message to an alternate location equipped with a terminal device and an auto-answer modem. The telephone number and the time of day to start and stop after hours processing shall be user designated.
3. Dial-up Communications: An autodial-up and auto-answer communications utility shall allow stand-alone System Application Controllers to communicate with remote operator station over voice grade phone lines.

N. ENERGY MANAGEMENT SOFTWARE
1. The following Energy Management capabilities shall be furnished standard as part of the building Automation System.
   a. Demand limiting Capability: The demand limiting program shall monitor building power consumption from signals generated by a pulse generator at the building power meter or from a watts transducer or current transformer attached to the building feeder lines.
   b. The demand limiting program shall be self-adjusting and shall control minimum of two independent demand limiting applications.

c. Demand limiting parameter shall include 15- or 30-minute intervals, shed/restore dead band with as well as maximum off-time and temperature limits for each load to ensure that Indoor Air Quality and occupant comfort are not compromised.
d. The HVAC equipment shall be protected by the anti-recycle timer described above.
e. Input capability shall also be provided for an end-of-billing period indication.

O. BUILDING MANAGEMENT SOFTWARE
1. Genera: The following Building Management capabilities shall be furnished as part of the Building Automation System:
2. Time Override: A timed override program shall be provided to enable to building operator to set up devices or groups of devices to be temporarily turned on for a defined period based on binary inputs, analog inputs, or CRT inputs.
3. Direct Digital Control: The Direct Digital Control Program shall allow modulating control of remote devices based on sensed data.
4. Custom Programming Language: A custom control language capability shall be provided to allow the operator to create real time, equation based, custom control routines.
5. Run Time Maintenance: The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts and/ or calendar date limits.
6. Expanded Messages: The user shall be able to define a minimum of 99–180-character messages for automatic printing in the event of system alarm and/or run time and maintenance event.
7. Reports and Logs: The system shall include the capability to store, review and print the following reports and logs. In addition, if a PC interface is specified, these reports shall be saved to diskette as an ASCII file for use by other owner furnished software packages.
    a. Current Summary Report: An instantaneous summary of building status including heating and cooling degree days, on and off-peak electrical demand performance, current KWH consumption and summary for critical temperature sensors listing today’s minimum and maximum values.
    b. Monthly Summary Report: An end of the month summary of building status including heating and cooling degree days, on and off-peak electrical demand performance, current electrical KWH consumption and summary for critical temperature sensors listing this month’s minimum and maximum values.
    c. Monthly Demand Limiting Report: A report for logging the electrical demand performance (both on and off peak), and the KWH consumption for each of the two utility meter programs shall be provided to the building operator. Included shall be the times of todays and yesterday’s demand peaks as well as the time and date of the monthly demand peaks. This report shall of electrical performance for the present day and pervious 32 days.
    d. Yearly Demand Limiting Repot: A report for logging the electrical demand performance (both on and off peak) and KWH consumption for each of the two utility meter programs. This report shall log electrical performance for the present month and previous 12 months.
    e. Yearly Meter Report: A report for logging the electrical KWH consumption for up to 6 sub meters. This report shall log electrical performance for the present month and previous 12 months.
    f. Yearly Degree Day Report: A current month and previous 12-month summary of heating and cooling degree days.
    g. Weekly Temperature Report: A previous 7-day summary of the minimum and maximum temperatures for the critical zone temperature sensors.
    h. Weekly Override Time Report: A pervious 7-day summary of after-hours override usage (in hours and minutes) for the timed override groups.

i. Monthly Override Time Report: A current and previous month summary of after-hours override usage (in hours and minutes) for the timed override groups).
j. Trend Logs: A custom report generator allowing the user to trend and store at least 24 sample points based on a user-defined schedule.
k. Event Logs: The system shall track system events including alarms, log-ons and diagnostics.
l. Input/output Status Reports: This reporting tool shall allow the operator to review the status of all system points.
m. HVAC Equipment Reports: Reports shall be provided which indicate the HVAC equipment status as well as the status of all input/output points of connected HVAC equipment.

P. ANTI-RECYCLE TIMER PROTECTION
1. A software program shall be provided to allow each individual piece of HVAC equipment to be individually programmable with “minimum on” and “minimum off” timers to protect HVAC equipment from rapid cycling due to system or operator error.

Q. LOCAL CONTROL PANELS
1. NEMS-1 locking panels shall house DDC controllers’ transformers, power supplies, communications interfaces, transducers/sensors that do not need to be field mounted, relays, wire termination/junction strips, etc.
2. Devices shall be flush mounted on panel face.
3. Manual timer overrides are not permitted. Manual overrides will be managed through a software function. If any manual override exists, they shall be removed as part of this project.
4. Internal components shall be securely mounted on removable sub-panels. Each component shall be individually labeled with function and device identification, as shown on control/interlock shop drawings. Label all components in accordance with Division 26 Electrical Identification.
5. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL-listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
6. Provide on/off power switch with over-current protection and a 1-½” main air gauge for control pressure sources to each local panel. Provide a 120-volt duplex outlet inside each control panel that houses a DDC controller (except VAV controllers) if there is not an outlet within 5’ of the enclosure.
7. All control panel locks shall be the same. Contractor shall give the keys to the District Controls Application Engineer at completion of training.
8. All field devices shall be mounted in panels. Exceptions include devices with enclosed electrical terminations, and designed to be installed on the controlled/monitored equipment and (e.g., pipe/duct temperature/pressure sensors) or those for space mounting (e.g., space temperature sensors)

PART 3 – EXECUTION

A. CONTROL WIRING
1. Provide all control and communication wiring (except CAT 6 for Ethernet/IP) including that for connecting equipment controls and Subsystems to the DDC System.
2. The Cat 6 wiring drops that interconnect the DDC System Controllers, equipment controls, and Subsystems, and the devices to the District Front End shall be installed by the telecom contractor.

3. Final wiring from the DDC System Controllers, equipment controls, and Subsystems to the drops shall be provided by the Controls Contractor.
4. Control wiring shall be concealed except in equipment rooms.
5. Electrical installation will be according to the following requirements:
    a. All wire and cable runs will be protected with metallic conduit or cable trays. Exceptions are as follows:
        1. NEC Class 2 low voltage wiring where not exposed to view such as above suspended ceilings, in shafts, etc., may be run in cable tray or properly secured to the building (when approved by code authority).
        2. Wiring enclosed in temperature control panels.
6. All wire and cable runs will be labeled or otherwise coded at both ends, the labeling or coding scheme should be well- organized, consistent, and documented (submitted).
7. All low voltage instrumentation wiring shall be minimum 18 AWG stranded copper for sensors and communication. All low voltage cables in ceilings shall be UL listed for air plenum service and suspended neatly from the overhead structure. Do not lay on top of ceiling tiles.
8. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than ½" electrical trade size shall not be used.
9. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.
10. Low-voltage (24V or less) AC or DC wiring shall not be run in conduit containing 120 VAC wiring.
11. Label all temperature control wiring junction box covers with an adhesive backed water-proof flexible mylar label with the letter's T/C, using an orange background with black letters to differentiate them from junction boxes installed by the electrical and fire alarm contractor. The labels shall be 3" x 3''.
12. Use proper size wire nut type connectors on all sensor wiring with factory recommended twisting.
13. Crimp connectors are not allowed on sensor wiring.

B. INSTALLATION AND SETUP REQUIREMENTS
    1. Install discharge air temperature sensors in all VAV boxes with reheat coils. Wire each sensor to an AI point termination on the box's associated Zone Controller.
    2. Averaging Sensor Elements, Low-Temperature Detection Elements
        a. The elements of averaging sensors shall be long enough to serpentine across the area served. The element shall cover the duct area completely and shall be equally spaced. Use copper radius clips at the bends and protect sensor elements at duct penetrations and other points of contact with poly-tubing.
        b. Low-temperature detection devices shall fully cover the coil face as described in the Part 2 Controls requirements. Mount and protect elements as described above.
        c. Sensing elements shall be located so as not to interfere with filter changing or other maintenance activities. The elements shall be mounted downstream of the coil served.
    3. Averaging-type sensing elements shall be supported in ductwork or air-handling units using ½" EMT or other auxiliary support.
    4. For all applications utilizing outside air, relief, isolation, or exhaust dampers: install an E/P to automatically close the dampers when its associated air-handling unit or fan is turned off. The E/P shall be wired so the damper is closed when the fan or AHU is turned off with the starter switch in the OFF or AUTO position (or in either the BYPASS or VFD modes when a variable-frequency drive is used). The dampers shall open, or return to automatic control, as required, when the fan or AHU is turned on, whether the starter switch is in the HAND or AUTO position (or in either the BYPASS or VFD modes when a variable-frequency drive is used).

5. The name of each point shall conform to the District's standard protocol. The intent is to utilize standard point names within a project and from one project to another. Consult District Controls Application Engineer for current standards.
6. Utilize programming protocol used by CSS whenever possible.

C. CONTROL DEVICE LOCATIONS
1. Outdoor temperature or RH sensors shall be located on the design drawings, and on a northern exposure, in a shaded location, preferably in a place where there is a continuous stream of outside air over the sensor, unless shown otherwise. Consult with the District Controls Application Engineer to determine the preferred locations.
2. Provide wind-dampening "weatherhead" with insect screen on outdoor atmospheric pressure-sensing point and mount at least 3' above the highest roof structure to minimize false readings due to wind direction and/or eddies.
3. Remote control devices not in local panels shall be accessible for adjustment and service, below 6' above finished floor whenever possible.

D. CONTROL PANELS
1. Electro-pneumatic switches (EPs) and relays shall be grouped together and installed in a single, central panel located next to the enclosure housing the associated controller. At the Contractor's option, the relays and EPs may be installed in the same enclosure as the controller. Remote mounted relays and EPs are not acceptable. Remote-mounted PE switches are allowed.
2. Electrical power for each panel shall be from a dedicated circuit. Where available in a building, utilize emergency power circuits for all controls. It is the A/E's responsibility to show a sufficient number of dedicated controls circuits in locations where control power will be needed on the electrical drawings. For retrofit applications, where connecting to existing control-power wiring, it is the Contractor's responsibility to verify that the power source is from a dedicated circuit. Note: Coordinate power sources with the Electrical Engineer, show all equipment requiring 120V power on the drawings.

E. IDENTIFICATION
1. All control equipment shall be clearly identified by control shop drawing designation code and a functional description as follows:
    a. Control valves: brass tags.
    b. Other remote-control devices and sensors (located both within and outside of control panels): metal tags, plastic laminate labels, or (on non-porous surfaces only) adhesive backed labels (i.e., from a laser printer or a dedicated label-making device). Do not attach tag or label to removable covers, adjacent surface etc.,
    c. Control panels: Engraved plastic laminate labels. Indicate panel number and systems served.
    d. All wiring, including wiring within factory-fabricated panels, shall be labeled within 2" of each termination with DDC point number/controller number or other descriptive information.
    e. Plenum-rated cabling shall use different jacket colors to differentiate between the following:
        1. Input point wiring.
        2. Output point wiring.
        3. Communications (i.e., MS/TP).
        4. Low Voltage power.
    f. All metal and plastic engraved labels shall be secured with chains, nylon tie-wraps, or rivets. Permanent adhesive is acceptable only when mechanical fasteners would damage the labeled equipment.

g. All switches, relays, and panel components shall be labeled. Relay bases shall be labeled, not the removable relay cube.
h. Labels shall not be mounted on removable surfaces, such as cable tray covers.

F. OPERATOR INTERFACE AND OTHER SYSTEM CONFIGURATION
1. General
a. All DDC System schedules, alarms and trends for this project shall be set up under this section.
b. Alarms and trends shall also be communicated to the DDC System's local Operator Interface until the District Front End or warranty period is complete.
c. Schedules shall also be available for modification from the local Operator Interface until the District Front End or warranty period is complete.
d. Consult with the District Controls Application Engineer to determine when the local Operator Interface functionality is no longer needed and disable any DDC System communications to the Operator Interface.
2. Graphics – Provide that specified by the A/E for use during system start-up, testing, commissioning, and the warranty period.
3. Alarms
a. Size DDC System controllers so that 48 hours of alarm information minimum can be stored at the building (not including any Operator Interface archiving capacity).
b. Set up alarms so that:
1. They are not issued when the associated system is off (e.g., an alarm for an AHU supply air temperature shall not be issued when the AHU is off).
2. The alarm limits vary with the associated operating mode (e.g., a space temperature's alarm limits changes between occupied and unoccupied modes).
3. The alarm limits vary with the associated set-point (e.g., an AHU supply air or space temperature's alarm limits vary with the set-point if reset).
4. Consult with the District Controls Application Engineer to determine the appropriate alarm limits.
c. The following data shall be associated with each alarm generated/stored by the DDC System:
1. Time and date of the alarm.
2. Alarm Priority
3. Event (alarm) type
4. A text description of the alarm condition including:
a. Location (building, floor, zone, office number, etc.).
b. Equipment (air handler #, pump, etc.).
5. Initiating device and object identifier
6. Acknowledgement time and date
7. Operator who issued acknowledgement.
d. Alarms shall be generated by the DDC System upon the occurrence of one of the following events (in addition to the specified in the Sequence of Operation):
1. Failure of a controller or any other DDC System hardware components.
2. Failure of communications between DDC System components; and between the DDC System and the District Front End, equipment controllers or Subsystems.
3. A monitored status indicating a discrepancy between the actual and the required value.
4. A monitored value does not meet criteria established by the operator.
5. The deviation of a variable from set-point exceeds operator-established criteria.
6. The output to a final control element is outside operator-established criteria.
7. A digital input is in the state defined by the operator as indicating an alarm condition.
8. Software failures and errors shall be diagnosed and annunciated by the BAS.
4. Trending

a. Size DDC System controllers so that 72 hours of trend information minimum can be stored at the building (not including any Operator Interface archiving capacity).
b. Set up trends in each associated General-Purpose Controller for all points using change-of value (COV) trending – consult with the District Controls Application Engineer to select the appropriate COV thresholds for analog points/data:
    1. All Temperature sensors
    2. All Pressure inputs excluding those used to sense flow.
    3. All Humidity sensors
    4. All Gas concentration inputs.
    5. All Current or Voltage inputs
    6. All Flow inputs
    7. Digital input status points
    8. All Analog outputs
    9. Data (virtual points) used for operator override software switches (e.g., for changing operating status of systems and/or used for switching system modes of operation)
c. Set up trends for each of the following Zone Controller, if applicable, using change-of-value (COV) trending:
    1. Space, Supply air and Coil Return Water Temperature
    2. Space/Zone Pressure
    3. Space or Exhaust Humidity
    4. Fan and Heat Pump Status
    5. Air Flow
    6. All Digital input status points
    7. All Occupancy status input points
    8. All Analog output points

5. Point/Data Naming – Use the convention jointly developed with the District Controls Application Engineer.
6. IP Addresses - Addressing shall be set up per the direction of the District Controls Application Engineer.

G. TESTING AND DEMONSTRATION

1. Prior to substantial completion, the control system shall undergo a series of tests to verify and demonstrate operation and compliance with this document. These tests and demonstrations shall occur after the Contractor has completed the installation, started up the system, and performed his own performance tests.
2. The tests and demonstrations described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process. Control system testing and demonstration shall be scheduled with the District Controls Application Engineer.
3. The Contractor shall provide at least two men equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation, including day, night, summer, winter, occupied, unoccupied, fire/smoke alarm, and power failure modes. The purpose is to evaluate and demonstrate the setup, calibration, response, and action of every point. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor. The District Controls Application Engineer, and District's HVAC representative shall observe and review these tests.
    a. The system software shall be complete such that each control loop shall function as specified in the Sequence of Operation. This Subcontractor shall be required to furnish the software program and evaluate the operation of every control loop.
    b. After all field connections have been made and control power is available in the control panel, the District Controls Application Engineer shall be notified, and the control system shall be energized. Any required reloading of the software shall be performed and

demonstration of the mechanical system, automatic temperature control system, and other connected systems shall commence.

c. This Subcontractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the specification. Control performance criteria is specified in the sequence of operations shown on the drawings and/or the specifications.

4. Operational logs for each system which indicate all setpoints, operating points, valve/damper positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover a 24-hour period and have a sample frequency of not more than 10 minutes. The logs shall be provided in printed and disk formats.
5. Control loops shall maintain setpoint within the following tolerances:
   a. Airflow ±100 cfm.
   b. Temperature ±1.0°F.
   c. Humidity ±5 percent relative humidity.
   d. Fluid pressure ±2.0 psi range 1 to 150 psi.
   e. ±2.0" w.g. range 0 to 50" differential pressure.
   f. Control loops that do not meet the above tolerances shall be re-tuned.
6. This Contractor shall demonstrate HVAC alarms prior to placing ventilation systems in service.
7. Participate in all tests required between the DDC System and the District Front End. Provide a protocol analyzer (i.e., Wireshark) for use in the testing.
8. The control systems will not be accepted as meeting the Requirements of Completion until all tests and demonstrations described in this section have been performed to the satisfaction of the District Controls Application Engineer.
9. After the system has operated properly for 90 days following startup of the final component of the heating and air conditioning systems, as-built copies of the software on electronic media and a printed copy shall be submitted to the Owner for permanent record purposes. Any software upgrading or enhancements to improve the system operation or as required for proper operation of the system during the first 24 months of operation is the responsibility of this Subcontractor. When changes are made to the software, the Contractor shall immediately provide updated copies of the files on floppy disks.

H. CONTROL EXECUTION – GENERAL

1. Provide independently adjustable, minimum ON and OFF timers for each start/stop point. Initially set times so as not to exceed six (6) starts per hour. On two-speed motors, provide a 20-second adjustable time delay when transferring from high-speed to low-speed, to allow the load to decelerate. This software time delay is in addition to the hardware time delay in the starters.
2. All setpoints, operating points, sequencing ratios, PID tuning parameters, and all other numeric and digital constants shall be adjustable by the user (with a high-level password) from the graphic. To change these values, the user shall not be required to modify program code, recompile, or download.
3. System logs, trend logs, and event-initiated logs shall be set up to provide historical and real-time monitoring of system operation. Logs shall be grouped by equipment.
4. Safety Shutdowns - General: all safety shutdowns of electrical equipment shall be hardwired. All shutdowns shall occur directly through interconnection of contacts on the safety device with the controlling circuit of the electrical equipment. Safety shutdowns through software are not acceptable. Interposing relays may be used only with prior approval of the District Controls Application Engineer when no alternative exists.

I. BAS SOFTWARE

1. Provide sufficient internal memory for the specified control sequences and logging. There shall be a minimum of 25 percent of available memory free for future use.

END OF SECTION

Guide Specifications

Energy Management and Control System

Cherry Creek School District

Setpoint Systems Corporation
8167 SouthPark Circle
Littleton, Colorado 80120

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

A. SECTION INCLUDES
   1. Related Sections
   2. Description
   3. Approved Control System Contractors and Manufacturers
   4. Quality Assurance
   5. Codes and Standards
   6. System Performance
   7. Submittals
   8. Warranty

B. RELATED SECTIONS
   1. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of this specification and shall be used in conjunction with this section as a part of the contract documents. Consult them for further instructions pertaining to this work. The System Integrator is bound by the provisions of Division 00 and Division 01.
   2. Section 01 33 23 – Shop Drawings, Product Data, and Samples

C. DESCRIPTION
   1. Provide a direct-digital control (DDC) system that will integrate into the Cherry Creek School District (CCSD) district-wide network per the project documents, point list, interoperability tables, drawings, and these specifications. Include all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.
      a. The DDC system shall consist of high-speed BACnet/IP or ethernet, peer-to-peer network of DDC controllers within each building. Each building shall be provided a BBMD and utilize BACnet/SC to provide remote access using any web accessible device to access the control system graphics and change adjustable set points with password protection.
      b. The direct-digital control system shall be BACnet. All new workstations, controllers, devices, and components shall be listed by BACnet Testing Laboratories (BTL) with accessibility using a web browser interface and shall communicate exclusively using the ASHRAE Standard 135 BACnet communications protocol without the use of gateways, unless otherwise allowed by this Section of the technical specifications, specifically shown on the design drawings.
         1) If used, gateways shall support the ASHRAE Standard 135 BACnet communications protocol.
      c. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required for complete and fully functional controls systems.

d. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The System Integrator administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any field controller, the control system shall continue to operate independently. Failure of the operator workstation(s) (OWS) shall have no effect on the field controllers, including those involved with global strategies.
e. The control system shall be accessible via web browser, no less than 1 OWS, and the control system shall accommodate 10+ web-based users simultaneously, and access to the system should be limited only by operator password. OWS to be provided by owner or SI contractor, project specific.
f. The control system will provide for future expansion to include monitoring of the card access, EPMS, irrigation, and lighting control systems.

D. APPROVED CONTROL SYSTEM INTEGRATORS AND MANUFACTURERS

The following are the approved Control System Integrator and manufacturers:

Company Name/Manufacturer	Address/Location	Contact
Setpoint Systems/Delta Controls	Denver, Colorado	Trey Sellers
TRYG Group		
Trane		

(NOTE: Contact CCSD on a per project basis for approved contractor)

Note:

a. The above list of Control System Integrators and Manufacturers are listed alphabetically and do not display a preference.
b. The Control System Integrator and Manufacture shall use only products from the corresponding manufacturer and product line listed.
c. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, building controllers, custom-application controllers, and application-specific controllers. All other products specified herein (e.g., sensors, valves, dampers, actuators, VFDs etc.) need not be manufactured by the above manufacturers.

E. QUALITY ASSURANCE

1. Control System Integrator and Manufacture Qualifications
   a. The Engineer(s), Installer(s), Technician(s), and Project Manager(s) shall have an established working relationship with the Control System Manufacturer of not less than three (3) years.
   b. The Engineer(s), Installer(s), Technician(s), and Project Manager(s) shall have successfully completed Control System Manufacturer's classes on the control system and shall have documented certification from the manufacture. The Engineer(s), Installer(s), Technician(s), and Project Manager(s) shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
   c. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Cherry Creek School District in writing. Spare parts shall be available for at least 5 years after completion of this contract. SI contractor responsible to make CCSD aware of any known products that are being phased out or the verge of becoming obsolete.

F. CODES AND STANDARDS
1. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes and standards:
   a. National Electric Code (NEC)
   b. International Building Code (IBC)
   c. International Mechanical Code (IMC)
   d. ASHRAE 55-2020
   e. ANSI/ASHRAE 62.1-2022
   f. ANSI/ASHRAE/IESNA 90.1-2022
   g. ANSI/ASHRAE 135-2020
   h. ANSI/ASHRAE/USGBC/IES 189.1-2020
   i. BACnet Testing Laboratories Certification (BTL Listed)
   j. UL508A Standard
   k. IEEE 802.1, 802.3
   l. ANSI/TIA/EIA-485-A-1998
   m. CCSD Products and Installation Standards

G. SYSTEMS PERFORMANCE
1. Performance Standards. The system shall conform to the following:
   a. Graphic Display: The system shall display a graphic with 20 dynamic points with all current data within 10 seconds.
   b. Graphic Refresh: The system shall update a graphic with 20 dynamic points with all current data within 5 seconds.
   c. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects shall start to adjust within 2 seconds.
   d. Object Scan: All changes of state and change of analog values will be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will have been current within the previous 60 seconds.
   e. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
   f. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. The System Integrator shall be responsible for selecting execution times consistent with the mechanical process under control.
   g. Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
   h. Multiple Alarm Annunciation: All workstations on the network must receive alarms within 5 seconds of each other.
   i. Network Speed: Minimum 100 Mbps between area and system controllers and all controllers residing on an RS-485/ MSTP network must have a minimum of 76 Kbps.
   j. Reporting Accuracy: The system shall report all values with an end-to-end accuracy as listed as or better than those listed in Table 1.
   k. Stability of Control: Control loops shall maintain measured variable at set point within the tolerances listed in Table 2.

Table 1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC [±1ºF]
Ducted Air	±0.5ºC [±1ºF
Outside Air	±1.0ºC [±2ºF]
Dew Point	±1.5ºC [±3ºF]
Water Temperature	±0.5ºC [±1ºF]
Delta-T	±0.15ºC[±0.25ºF]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale.
Air Pressure (ducts)	±25 Pa [±0.1" W.G.]
Air Pressure (space)	±3 Pa [±0.01" W.G.]
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power factor)	5% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

Note 1: 10%-100% of scale.
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters.

Table 2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa [±0.2" w.g.]	0-1.5 kPa [0-6" w.g.]
	±3 Pa [±0.01" w.g.]	-25 to 25 Pa [-0.1 to 0.1" w.g.]
Air flow	±100 cfm	
Temperature	±0.5ºC [±1.0ºF]	
Humidity	±5% RH	
Fluid Pressure	±10 kPa [±1.5 psi]	0-1 kPa [1-150 psi]
	±250 Pa [±1.0" w.g.]	0-12.5 kPa [0-50"w.g.] differential

H. SUBMITTALS

1. Product Data and Shop Drawings: Meet requirements of Section 01xxxx on Shop Drawings, Product Data, and Samples. In addition, System Integrator shall provide shop drawings or other submittals on all hardware, software, and installation to be provided. No work shall begin on any segment of this project until submittals have been reviewed and approved for conformity with the design intent. Two hard copies and one electronic copy are required. All drawings shall be created on AutoCAD Release 2022 or higher and provided on a flash drive. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include:
   a. Building Control System Hardware:
      1) A complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data.
      2) Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for the items listed below, and other relevant items not listed below:

i) Direct Digital Controller (controller panels)
ii) Transducers/Transmitters
iii) Sensors (including accuracy data)
iv) Actuators
v) Valves
vi) Relays/Switches
vii) Control Panels
viii) Power Supply
ix) Batteries
x) Operator Interface Equipment

3) Provide floor plans highlighting the locations of all equipment / systems / room sensors and control panel locations.

b. Central System Hardware and Software:
1) A complete bill of material of equipment used indicating quantity, manufacturer, model number, and other relevant technical data.
2) Manufacturer's description and technical data, such as product specification sheets and installation/maintenance instructions for the items listed below and other relevant items not listed below:
i) Computers / Servers
ii) Monitors
iii) Power Supply
iv) Battery Backup/UPS
v) Network Switches
vi) Operating System Software
vii) Operator Interface Software
viii) Graphic Software
ix) Third-party Software
x) License Agreements and Minimum Duration of Warranty
3) Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with function. Show all interface wiring to the control system.
4) Riser/one-line/Architectural diagrams of wiring between all control panels.
5) A list of the color graphic screens (storyboard) to be provided. Provide as a minimum the following:
i) Building rendering and/or campus depiction
ii) Riser/one-line/Architectural diagrams
iii) Flow Diagrams of all equipment/ systems that are controlled and monitored.
iv) Floor plans that identify all locations of equipment and/or systems
v) Each storyboard graphic shall display the following if applicable:
1. Inputs
2. Outputs
3. Set point Adjustment.
4. Schedules
5. Command on/off
6. Programs
7. Trend logs
8. Outside conditions
9. Alarms
10. Datasheets

c. Controlled Systems:

1) A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
2) An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
3) A mounting, wiring, and routing plan view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
4) A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
5) A point list for each system controller including both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, and the location of the I/O device, software flag points, alarm points, spare capacity on blank modules, etc.

2. Schedules:
   a. Within one month of contract award, provide a schedule of the work to Cherry Creek School District facility and construction departments indicating the following:
      1) Intended sequence of work items.
      2) Start dates of individual work items.
      3) Duration of individual work items.
      4) Planned delivery dates for major material and equipment and expected lead times.
      5) Milestones indicating possible restraints on work by other trades or situations.
      6) Provide weekly written status reports indicating work completed, revisions to expect delivery dates, etc. An updated three week look ahead project schedule shall be included. Three week look ahead schedule shall include as a minimum: Manpower loading, major milestones, any and all encumbrances.
3. Project Record Documents: Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include the following:
   a. Project Record Drawings: These shall be as-built versions of the submittal shop drawings. One set of .pdf and CAD files also shall be provided.
   b. Testing and Commissioning Reports and Checklists: Completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3: "Control System Demonstration and Acceptance."
   c. Certification of the pressure test required in Part 3: "Control Air Tubing."
   d. Operation and Maintenance (O & M) Manual: This shall include as-built versions of the submittal product data. In addition to the information required for submittals, the O & M manual shall include
      1) Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.
      2) Operator's Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point reports,

trending data, overriding computer control, and changing set points and other variables.

3) Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
4) A listing and documentation of all custom software created using the programming language, including the set points, tuning parameters, and object database. One electronic set containing files of the software and database also shall be provided.
5) One electronic set of files of all color graphic screens created for the project.
6) A list of recommended spare parts with part numbers and suppliers.
7) Complete original issue documentation, installation, and maintenance information for all third-party hardware provided, including computer equipment and sensors.
8) Licenses, guarantee, and warranty documents for all equipment and systems.
9) Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

4. Training Manuals: The System Integrator shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Engineer may modify any or all of the training course outline and training materials to meet the needs of the Owner. Review and approval by the Engineer shall be completed at least three weeks prior to the first class.

I. WARRANTY

1. Warrant all work as follows:
   a. Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The System Integrator shall respond to the Owner's request for warranty service within 24 hours during normal business hours.
   b. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system startup. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

PART 2 - PRODUCTS

A. SECTION INCLUDES
   1. BAS Architecture and General Requirements
   2. Operator Workstation
   3. Building Controllers
   4. Application Specific Controllers
   5. Application Controllers
   6. Point Expansion Module
   7. Building Router
   8. Auxiliary Control Devices - Electronic
   9. Valves
   10. Dampers
   11. Actuators
   12. Transformers, Power Supplies and Line Filtering
   13. Wiring and Raceways
   14. Fiber Optic Cable System
   15. Refrigerant Leak Detection
   16. Sensors/Transmitters
   17. Variable Frequency Drives
   18. Emergency Power Off Switches

B. BAS ARCHITECTURE AND GENERAL REQUIREMENTS
   1. Provide a minimum of one BTL-listed BACnet BBMD DDC Router. More than one DDC Router or Panel may be needed to meet the requirements in the remainder of this paragraph.
   2. All DDC routers/panels shall be connected together by the "DDC Router Network" (BACnet/IP).
   3. Remote Communications: The BAS shall be remotely accessible via an Internet connection provided by others.
   4. A sufficient number of DDC routers/panels/controllers shall be provided to meet the memory needs of the project programming, alarming and trending (24 samples for each point alone, not including that needed for Measurement and Verification (M&V)) along with 25% spare capacity for future use. Point termination types shall include:
      a. Analog Input (AI) – Thermistor, 0-10 VDC or 4-20 mADC
      b. Binary Input (BI) – Monitoring of dry contacts, including contact closure "pulses" up to 10 per second.
      c. Analog Output (AO) - 0-10 VDC, 0-20 VDC or 4-20 mADC.
      d. Binary Output (BO) - Two state DC voltage signal or magnetically held dry contact closure.
   5. Each area, system, and application controller shall continue to execute its control software, sample input points, and update output points without connection to the DDC panel network, Controller network or an operator interface.
   6. See the Sequence of Operation for the specific type of DDC device acceptable for each system/equipment controlled/monitored. General requirements include the following:
      a. An application-specific controller shall not be used for systems/equipment that require custom application programming to meet the Sequence of Operation (i.e., if an application-specific controller is used the factory-provided control software, program must be able to perform the Sequence of Operation without "upper level" control from a DDC panel, etc.).

b. If a DDC controller is listed as acceptable for a system/equipment, the System Integrator may alternatively provide a DDC Router (with point expansion or Panel).

7. Digital Communications to Third-party Controls
   a. The BAS is required to send/receive information via digital communication technologies (e.g. Ethernet/IP, EIA-485); application protocols (e.g., BACnet Modbus) to specified Third-Party controls provided under this or other sections of the specification (e.g. chillers, VFDs, BTU meters, electrical submeters, lighting controls, etc.).
   b. See the Specification sections of the equipment involved (e.g. 25 52 23 for the boilers), the type of communications technology/interface (e.g. the data link layer protocol), and application protocol used by each of the Third-Party controls, and for the list of data to be shared with these controls.
   c. Communications not requiring a gateway (i.e., BACnet): Design the BAS to include the DDC device models (with optional modules if necessary) that provide the necessary data link layer interfaces.
8. Communication Requiring Gateway (i.e., Modbus): Design the BAS to the BAS Controller models (with optional software "drivers" and/or hardware if necessary) that provide the necessary data link layer and application protocol gateway interfaces.

C. OPERATOR WORKSTATION
1. Operator Interference Software - The software shall include the following capabilities:
   a. Graphic screens display of custom graphic screens with dynamic point information and the ability to show animation by shifting image properties based on the status of the point.
      1) NOTE - The terms "graphic screens" and "graphic(s)" in this specification refers to graphical images viewed via a PC running operator interface software (a "thick client") or a PC viewing graphical images on web pages via a web browser (a "thin client").
      2) Graphic Generation: Graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as AutoCAD.
      3) Graphics Library: Furnish a library of standard HVAC system/equipment graphics screens such as chillers, boilers, air handlers, terminals, fan coils, unit ventilators, etc.; and standard symbols for HVAC components including fans, pumps, coils valves, piping, dampers, ductwork, etc.
2. System Applications- Provide the following:
   a. System Databases Save and Restore: Automatic (when changes occur) and/or manual backup of the system database (e.g., a DDC panel point database and/or control program). The operator shall also be able to manually initiate a download of a specified database to any DDC device in the BAS.
   b. System Configuration: Provide application for BAS configuration (DDC device communications addressing, point definition, etc.).
   c. Help: Provide a context sensitive help system to assist the operator in operation of the BAS.
   d. Security: Each operator shall be required to log on to the BAS with a unique name and password in order to view edit, or delete data. System security level shall be configurable for each operator via the site administrator login.

e. System Diagnostics: the System shall automatically monitor the operation of all DDC devices including network communications and provide an alarm when a failure occurs.
f. Standard BAS Operating Features:
    1) Point/Data Overrides/Modifications: Output points and system data (i.e., set points) shall be modifiable (i.e., auto vs. manual and overridden value) via a link to each item's graphic screen image.
    2) Alarm Processing: An alarm log with acknowledgement and alarm clearing functions, the ability to configure alarm limits, and system reactions (e.g., an alarm message, communications method, etc.).
    3) Trend Logs: The ability to define a custom historical trend log for any data in the system. The data can be displayed tabular or graphical.
    4) Scheduling: A graphical method for scheduling equipment operation including normal, holiday and exception scheduling.
    5) Manage HVAC, lighting and access systems from a single graphic package.
    6) Utilize real time 3-D graphics for building control and visualization.
    7) System must automatically discover newly connected BACnet devices.
    8) System must be able to natively generate reports
    9) System must be capable of printing, texting and emailing alarm notifications.
    10) System must be able to analyze/display no fewer than eight trend logs in a real-time graph.

3. Control Software Editors: The software shall allow for Operator editing of all control applications including the following:
    a. Application Specific Controller: A full screen graphical editor for each type of application that allows the operator to view and change the configuration, name control parameters, and set points for all controllers.
    b. Custom Control Programming: A graphic for creating, modifying, and debugging the custom control programming for all routers/panels controllers.
    c. Graphic Design Software: Software for generating new real-time 3-D graphics for use in the operator workstation. All graphics shall be developed with Delta Controls enteliVIZ HTML5 or approved vendor equal.
4. Web Server: Delta Controls enteliWEB Enterprise Facility and energy Management eWEB-ENT (unlimited I/O, Multiple Sites, Dashboards, Alarms, Basic Energy) or Niagra N4. This shall, as a minimum allow thin clients (PC's running web browser software) to perform all the capabilities described above except Graphic Generation, System Database and Restore, System Configuration, and Control Software Editors.
    a. The software shall support an unlimited number of points and an unlimited amount of thin client users.
    b. Point/Data Overrides/Modifications: Output points and system data (i.e., set points) shall be modifiable (i.e., auto vs. manual and overridden value) via a link to each item's graphic screen image.
    c. Alarm Processing: An alarm log with acknowledgement and alarm clearing functions: and the ability to configure alarm limits, and system reactions (e.g., an alarm message, communications method, etc.).
    d. Trend Logs: The ability to define a custom historical trend log for any data in the system. The time stamp data can be displayed tabular or graphical.
    e. Scheduling: a graphical method for scheduling equipment operation including normal, holiday and exception scheduling.

f. Manage HVAC, lighting and access systems from a single seat front end package.
g. Utilize real time 3-D graphics for building control and visualization.
h. The system is to utilize a Windows based object-oriented navigation system.
i. The system shall allow tenant access to view and adjust local set point as well as view equipment in their space.
j. System must be capable of printing and emailing alarm notifications.
k. System must support multiple languages with the capability for the user to change the language at any time.
l. System must analyze no fewer than eight trend logs in a real-time graph.

5. Historical Data Management: Shall have the capability to record extended periods of data from the DDC system which shall be integrated and viewable within the operator workstation. The historical system should automatically restart following a power failure and will automatically determine the optimal time to back up data from the controllers to minimize data loss. The data should be stored in a SQL database to allow for access from third-party tools.
6. Other requirements:
   a. Acceptable Manufacturers and System Integrators
      1) Only the following manufacturer/system Integrators (representing the product lines, if listed) are acceptable:
         i) Delta Controls installed by Setpoint Systems Corporation
         ii) TRYG Group
         iii) Trane
   b. All BAS components shall be by one of the above manufacturers, except when "controls provided with the unit," "factory-mounted controls," "unit manufacturer provided controls," etc, are referenced by this specification, "BAS Components" includes BAS Panels/Routers/controllers, and operator interface, color-graphics interface, control and programming software. Valves, actuators, sensors, conventional thermostats and other stand-alone controls and other field devices need not be by the same manufacturer.
   c. Third-Party Software: Provide any other software needed for the operation of the operator interface software, such as Microsoft SQL or .NET, .JFS, Excel, etc.

D. BUILDING CONTROLLERS
1. Building Controller is BTL-listed BACnet B-BC device as defined below with non-volatile memory for operating system software; read/write memory for custom programming; communications support for operator interface and the Controller Network.
   a. Delta Controls- eBMGR v4.0
   b. Delta Controls- eBCON v4.0
   c. Delta Controls- DSC-1616E or DSC1212E v3.40
   d. Cbx-8R8-H
   e. CCSD Approved Equivalent
2. Building Controller Network- Provide 100 Mbps BACnet Ethernet/TCP-IP communications (as a master).
3. Controller outputs to have integral HOA switches
4. Owner to approve panel locations
5. Point Termination-building controllers shall provide direct point termination through integral point connections, point expansion and/or point expansion modules.

a. Point expansion shall communicate with the Building Control Panel via the Panel's microprocessor bus (i.e., they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).
b. A "point Expansion Module" as defined below shall be installed within the same enclosure as the associated Building Control Panel.

E. APPLICATION SPECIFIC CONTROLLERS
1. An application Specific Controller is a BTL- listed BACnet B-AAC or B-ASC device dedicated for use with specific equipment and applications. It shall be provided with the no volatile memory for operating system software; read/write memory for all other purposes; factory-provided control software; and communications support for operator Interface, and the Controller network.
2. Application Specific Controller shall only be used for terminal/zone equipment such as VAV terminal units, constant-volume terminal units, fan coil units, and heat pumps (i.e., when the factory-provided control software meets the Sequence of Operation) or where explicitly allowed by the Sequence of Operation.
   a. ASC's for pressure-independent VAV-terminal-unit control shall have an integral differential pressure sensor for air flow measurement and an integral damper actuator.
3. Each ASC shall have a 76.8Kbps BACnet MS/TP or BACnet/IP Controller Network connection.
4. Acceptable ASC controllers:
   a. Delta Controls- DVC-Vxxx v3.40
   b. Delta Controls- DAC-Vxxx v3.40
   c. Delta Controls- RED5-EDGE-xxx v4.0
   d. Delta Controls- RED5 FIELD-xxx v4.0
   e. Delta Controls- eZNT-xxx v3.40
   f. Delta Controls – Edge v4.0
   g. CBV-2U4-3T
   h. CCSD Approved Equivalent
5. Integral HOA switches are NOT required.
6. Owner to approve panel locations.

F. APPLICATION CONTROLLERS
1. A DDC panel is a BTL-listed BACnet B-BC or B-AAC device with the BACnet options specified below, non-volatile memory for operating system software: 72-hour battery-backed read/write memory for custom control programming, trending, and alarming; integral point or point expansion terminations; and communications support to other DDC routers/panels.
2. DDC Router/panel Network: Provide 100 baseT Ethernet minimum communications with BACnet/IP support for interconnection to other DDC routers/panels, operator interfaces, and to an Internet/intranet connection, if specified.
3. Point Termination-DDC panels shall provide direct point termination through integral point connections, point expansion, and/or point expansion modules.
   a. Point expansion shall communicate with the DDC panel via the Panel's microprocessor bus (i.e., they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).
   b. A "Point Expansion Module" as defined below shall be installed within the same enclosure as the associated DDC panel.
4. Optional Controller Network- A DDC panel may provide the following:

a. Communications support as a Master to one or more 76.8Kbps BACnet MS/TP data-link layer communications connections for DDC controllers and application-specific controllers.
b. BAC Clause 6 Routing (between the specified DDC Router/Panel and controller Network technologies) and BACnet/IP Broadcast Management (BBMD).

5. Acceptable AAC Controllers:
   a. Delta Controls-DAC-xxxx v3.40
   b. CCSD Approved Equal

G. POINT EXPANSION MODULE
1. A point expansion module provides slaved control (i.e., it does not execute its own control software) via a serial or multi-drop communications connection (e.g., EIA-485, MS/TP, etc.) from a DDC device.
2. A point expansion module cannot be used as a DDC router/panel/controller or Application specific Controller, and shall be mounted within the same enclosure as the DDC router/panel/controller is serves.
3. Acceptable expansion modules
   a. Delta Controls- eBX-xxx v3.40
   b. Delta Controls- DFM-xxx v3.40
   c. Flx-8R-h
   d. CCSD Approved Equal

H. BUILDING ROUTER
1. A Building Panel is BTL-listed BACnet B-BC or B-AAC device with the BACnet options specified below, non-volatile memory for operating system software; 72-hour battery-backed read/write memory for custom control programming, trending, and alarming; real time clock; integral point or expansion terminations; and communications support to other DDC routers/panels.
2. Building Router/Panel Network: Provide 10/100 Mbps Ethernet minimum communications using the BACnet/IP data link layer for interconnection to other DDC routers/panels, operator interfaces, and to an Internet/Intranet connection, if specified.
3. Routing: Provide BACnet Clause 6 Routing (between the specified DDC router and controller network technologies) and BAC/IP Broadcast Management (BBMD).
4. Controller Network: A building router shall be a Master to one or more 10/100 Mbps BACnet DDC controllers and application-specific controllers.
5. Optional Point Termination- Building routers may be utilized for direct point termination through integral point connections, point expansion and/or point expansion modules.
   a. Point expansion shall communicate with the Building Router via the Router's microprocessor bus (i.e., they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).
   b. A "point expansion module" as defined below shall be installed within the same enclosure as the associated Building Router.
6. Acceptable Building Routers everything with a motor needs a current sensor
   a. Delta Controls- eBMGR-2
   b. CCSD Approved Equal

I. AUXILIARY CONTROL DEVICES - ELECTRONIC
1. Control relays: Plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage suitable for the application.

Electronic relay shall be Functional Device RIBU1C, RIBMU1C, RIBRL1C. No exceptions.

2. Low-Temperature Detection Switches (Freeze-stats): Provide SPDT low temperature-protection thermostats of manual-reset type, with sensing elements of the proper length, but in no case less than 20'-0" in length. Provide thermostat designed to operate in response to coldest 1'-0" length of sensing element, regardless of temperature at other parts of element. Support element properly to cover entire duct width. Provide separate thermostats for each on 25 sf of coil face area or fraction thereof. The setpoint shall be 38F adj unless otherwise specified on the plans or sequence of operations. Siemens, low limit thermostat 134-1504, 15-55° F, manual lockout with remote reset or equivalent by Honeywell.
3. Current Sensing Switches: Use for all motor-status BI point unless otherwise noted; shall be self-powered, solid-state with adjustable trip current. The switch shall be selected to match the current of the application and input requirements of the BAS. Veris Industries Current Switch H608 split core adjustable. For ECM motor applications use Veris Industries HCECM05 current switch. No exceptions
4. Differential Pressure Switches: Used only for duct pressure safety cutoffs unless otherwise noted. Adjustable trip pressure with range suitable for the application. Greystone Differential Pressure switch AFS222, auto reset, 0.5 to 12 inches of water column. No exceptions.
5. On–Off thermostats: Provide thermostats of bi-metal actuated open contact, bellows-actuated enclosed snap-switch type, or equivalent. Provide solid-state type with electrical rating to meet the application. Provide with surface mounted ventilated enclosure. Siemens electric surface mounted thermostat 141-0522. No exceptions.

J. VALVES
1. Control Valves: Provide factory fabricated control valves of appropriate pressure class for the scheduled service. Provide size-modulating valves for a pressure drop, provided by consultant, for water service and 80% of the supply pressure for steam service, unless otherwise noted. Two-position valves shall be line size.
   a. Water Service Values: Equal percentage characteristics with range ability of 50 to 1, and maximum full flow pressure drop of 5 psig.
   b. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
   c. Double Seated Valves: Balanced plug type, with cage trim providing seating and guiding surfaces on "top and bottom" guided plugs.
   d. Valve Trim and Stems: Polished stainless steel.
   e. Packing: Spring-loaded Teflon, self-adjusting
   f. Valves: NPS 2-1/2" through 6": Globe valve with bronze body, brass plug flanged ends.
   g. Valves: NPS 2 and smaller: Ball valve with characterized disk, Class 125 forged brass body, brass ball
   h. Belimo valves. No exceptions
2. Butterfly Valves: high performance valves with stainless steel disc and PTFE steel ring shall be used. Body shall be carbon-steel body, 150 lb. full ANSI rated bi-directional, lug style butterfly type, bi-directional dead end pressure rating of 285 psi, and temperature rating of -20 to 300 degrees F. Construction features to include 316 SS electroless nickel plated eccentric rotating disc, dynamic sealed, PTFE seal ring, 17-4 Ph (ASTM A 564 Cind. H1075 or H1100) stainless steel shaft, TFE chevron stem packing SS/DU TFE removal of downstream piping and shall be factory pressure tested to 110% of pressure rating. Valves shall be

installed by use of cap screws; threaded rod not acceptable. Belimo, Keystone or approved equal.

K. DAMPERS
   1. Dampers: AMCA-rated, parallel or opposed-blade design as indicated; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
      a. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
      b. Operating Temperature Range: From minus 40 to plus 200 deg F.
      c. Edge Seals, Low-Leakage: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x Ibf; when tested according to AMCA 5000.
      d. Ruskin CD40 or CD50 aluminum. No exception

L. ACTUATORS
   1. Electronic
      a. Design for direct mounting on the device and attachment to the driving shaft (damper actuator only); adjustable angle of rotation or range of actuation; and built in overload protection. Size each motor for 150% of the application requirement and with sufficient reserve power to provide smooth action.
      b. Modulating actuators shall use a 0-10 VDC signal input to match DDC device AO signal output, and 24 VAC power.
      c. Two-position actuators shall be a 24 VAC, two-wire, spring return. Spring actuation return actuation time shall be less than 30 seconds.
      d. Damper Actuators - 90° rotation maximum, with built-in adjustable mechanical stop to limit rotation to that of the damper and/or to meet TAB requirements.
      e. End switches- Provide actuator with integral, adjustable-position indication end switches (one for each fully actuated position) when the actuated device is specified with an end switch binary input point(s). All intake hoods must include end switches.
      f. Belimo Actuators (Series L). No exception
   2. Provide valve actuators capable of close-off against a pressure greater than the respective pump system shut-off head.
   3. Failsafe: Provide spring-return failsafe upon load of power or control signal to the positions as follows:
      a. OA dampers- N.C.
      b. Return-air dampers- N.O.
      c. Relief- and exhaust-air dampers- N.C.
      d. HW Valve – NO
      e. CHW Valve – NC
      f. VAV Box RH Valve - Last

M. TRANSFORMERS, POWER SUPPLIES AND LINE FILTERING
   1. Transformer enclosed Dual 100VA Split-bobbin
      a. Over Current Protection: Circuit Breaker
      b. Temperature: 40° C

c. Approvals: Class 2(UL Approved UL5085-3), UL916, UL508, C-UL, CE, RoHS
d. Main Breaker on/off: Two 100 VA Split-Bobbin Circuit Breaker 50/60 Hz On / Off Switch & Breaker Switch / Breaker (10 Amp) (Kills power to entire unit: Outlets, Aux. Output, & Transformer)* Total Combined Output 9A

2. Power Supply shall be UL Listed. Furnish Class 2 current limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80% of rated capacity.
   a. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak to peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built in over-voltage and over-current protection and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.
      1) Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.
      2) Line voltage units shall be UL Recognized and CSA Approved.
      3) TDK Lambda 10W DIN Rail VDC Power Supply DSP10-24. Or approved equal

N. WIRING AND RACEWAYS
1. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 26.
2. All insulated wire to be copper conductors, UL labeled for 90C minimum service
3. All wire shall comply to the following:

Color/Size/Wire	System
Red/18 TFF/MTW Stranded	24VDC Positive
Black/18 TFF/MTW Stranded	24VDC Negative
Blue/14 THHN Stranded	24VAC Hot
White/14 THHN Stranded	24VAC Neutral
Orange/18 TFF/MTW Stranded	Inputs
*Orange/Black Tracer/18 TFF/MTW Stranded	Inputs (ground)
Brown/18 TFF MTW Stranded	Outputs
*Brown/White Tracer/18 TFF/MTW Stranded	Outputs (ground)
Purple/14 THHN Stranded	24VAC Hot Interlock
Gray/14 THHN Stranded	24VAC Neutral Interlock
Black/12 THHN Stranded	120VAC Hot
White/12 THHN Stranded	120VAC Neutral
Blue 24 TSP	MS/TP & Modbus Wiring
Green CAT5 or 6	Ethernet

O. FIBER OPTIC CABLE SYSTEM
1. Optical cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Section 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
2. Connectors: All optical fibers shall be field terminated with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

P. REFRIGERANT LEAK DETECTION
1. Provide a minimum of one permanently mounted continuously operating refrigerant vapor compound-specific monitor with a pickup/sensor in each chiller

room to detect leakage of refrigerant from locations where the refrigerant is either stored or used.

2. Multiple monitors or monitor pickup points shall be used to limit the distance between the sensor and the refrigerant source to not more than 50 feet. Monitor sampling point(s) shall normally be located 18 inches above the floor in location near the refrigerant source and shall be situated between the refrigerant source and the exhaust fan inlet.
3. Refrigerant monitor shall be capable of detecting concentrations of 1 ppm. It shall be supplied factory calibrated for the applicable refrigerant used in the project and shall coordinate with selected chiller.
4. Monitor shall provide an alarm relay output for each pickup which energizes when the monitor detects a refrigerant level at or above the TLV-TWA. This relay shall be used to energize a flashing light and audible alarm outside the chiller room entrance, as an alarm status input to the BAS, and shall be used to activate the emergency purge ventilation system according to the Sequence of Operation.
5. Monitor shall provide a failure relay output that energizes when the monitor detects a fault in its operation. Faults include low air flow through the monitor, circuit failure, and a saturated or absent sensor signal.
6. Monitor shall be certified to UL 2075 and CSA 22.2
7. Approved Manufacturers/Products- MSA Chillgard RT Refrigerant Monitor or approved equal.

Q. SENSORS/TRANSMITTERS

1. Temperature Sensors: Thermistor or RTD with a minimum accuracy of +/0.5 degrees F throughout the specified temperature range.
   a. Duct: Utilize a capillary type (20’ min.) averaging sensors for all mixing box applications and supply ducts with a cross sectional area in excess of 20 square feet; 0 to 100°F range. Greystone Average sensors four analog average, high, low or two difference output 6N1-ISO. No exceptions.
   b. Outside Air: -30°F to 120°F range. Watertight inlet fitting shielded from direct sunlight. Greystone OSA c/w sunshield/windshield TE200F7. No exceptions.
   c. Pipe: 20 to 220 degrees F. Immersion style with thermowells: Series 300 Stainless steel for steam lines; stainless steel of brass, for water lines. Greystone Duct Sensor Greystone Duct/ immersion temperature sensor with ABS enclosure DTS-ABS2. No exceptions.
   d. Space: Surface-mounted, ventilated enclosure with set point adjustment, unoccupied-mode override button, and temperature indication. Space sensors used for terminal unit control shall have an integral part that is connected to the corresponding controller’s operator interface port. 50 to 90 degrees F. range.
   e. Public Spaces (excluding gym): Greystone space temp sensor 10K stainless steel flat plate sensor TE200AS7. No exceptions.
   f. Gym (Single Zone Units): Stainless Steel flat plate sensor with CO2 in return air duct
2. Flow Elements/Transducers:
   a. VAV terminal Unit: Provide differential-pressure transducer integral to the application-specific controller. Connect to pitot-tube element provided with terminal unit.
   b. Chilled Water or Condenser Water Flow: Onicon F3500 electromagnetic flow meter. No substitutes.

3. Differential Pressure Sensors: Differential pressure sensors (air or water) shall be temperature compensated with an accuracy of +/-1% of range and hysteresis of 0.5% of range. Jumper selectable ranges; Veris PX3 no exceptions

   Duct static 0 to 5", Bldg Static -0.25 to +0.25, Mixed Air Plenum -0.25 to +0.25, Return/Mixed Air Plenum -1" to 1" *reference to product table ranges.
   a. Air: Sensor shall be able to withstand a maximum port pressure of 10psig.
   b. Water: Wetted parts shall be stainless steel; sensor shall be able to withstand a maximum port pressure of 250psig and a maximum differential pressure of 150psi or 300% of the rated range, whichever is greater. Add: digital readout; service ports built-in
4. Airflow Measuring Station:
   a. Shall be a thermal dispersion airflow sensor.
   b. An accuracy of +/- 2% for airflow
   c. Shall include an integrated LCD display.
   d. Shall include manual controls for sensor settings and configurations.
   e. Network connectivity shall be BACnet/IP, Ethernet, or MS/TP
   f. Approved Manufacturers: EBTRON; no exceptions
5. Carbon Monoxide (CO) Controllers (for Parking Garage CO Purge, Boiler rooms)
   a. Combination controller/sensor or separate controller with multiple remote-mounted sensors. Design shall be for room (not duct) applications. Greystone CMD5B4000 sensor or approved equal.
   b. Each controller shall have an integral LCD, dry contact alarm relay, and buzzer.
   c. Provide one controller per parking level minimum (per 5,000 SF) (applicable to controller with separate remote-mounted sensors only).
   d. Provide a sufficient number of controller/sensors or sensors based on the manufacturer coverage data.
   e. Set the unit to close the alarm relay based on the manufacturer-recommended time-based set points needed to meet all applicable codes/standards.
6. Carbon Dioxide (CO2) Sensors
   a. Provide non-dispersive infrared (NDIR), Diffusion sampling CO2 sensors with integral transducers and linear output. Linear, CO2 Concentration Range Display: 0 to 2000 ppm.
   b. Accuracy: Plus/minus 2 percent of measured value, measured at NTP.
   c. Repeatability: Plus/minus 20 ppm or plus/minus 2 percent of measured value.
   d. Response time: less than 60 seconds for 90 percent step change.
   e. Output: analog 4-20mA.
   f. Air Temperature: range of 32 to 122 degrees F.
   g. Relative Humidity: Range of 0 to 95 percent (non-Condensing).
   h. Power Input: Class 2; 12 to 30VDC or 24VAC 50/60 Hz; 100mA max
   i. Calibration characteristics: Automatically compensating algorithm for sensor drift due to sensor degradation, Maximum Drift: 2 percent.
   j. Greystone duct sensor CO2 CDD4A200, Greystone space CO2 sensor CMD5B4000. No Exceptions or approved equal.

R. VARIABLE FREQUENCY DRIVE
1. Where shown on the drawings, adjustable frequency drives 0.50 through 800 HP shall have the following features:
   a. The VFD shall provide microprocessor-based control for three-phase induction motors. The controller's full load output current rating shall be

based on a low overload application at 40□ C ambient and 1.5 - 10 kHz switching frequency with automatic switching frequency de-rating in case of overload.

b. The VFD's shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source VFD's are not accepted. Insulated Gate Bipolar Transistors (IGBTs) shall be used in the inverter section. Bipolar Junction Transistors, GTOs are not accepted. The VFD shall run at the above listed switching frequencies.
c. The VFD's shall have an efficiency at full load and speed that exceeds 97%. The efficiency shall exceed 90% at 50% speed.
d. The VFD's shall maintain a minimum line side displacement power factor of 0.96, regardless of speed and load for VFD's less than 75 HP. The VFD's shall maintain a minimum line side displacement power factor of .99, regardless of speed and load for motors greater than 75 HP.
e. The VFD's shall have a one (1) minute overload current rating of 110% for low overload applications.
f. The VFD's shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the VFD.
g. The VFD's shall have an integral EMI/RFI filter as standard.
h. VFD must contain a circuit breaker, fused disconnect is not acceptable.
i. When requested, harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the drawings, and the total system load. The calculations shall be made with the point of common coupling (PCC) being the point where the utility feeds multiple customers.
j. Total harmonic distortion shall be calculated based on total demand distortion conditions as defined in IEEE 519-1992. Copies of these calculations are to be made available upon request. The System Integrator shall provide any needed information to the VFD supplier three (3) weeks prior to requiring harmonic calculations.
k. The VFD's shall be able to start into a spinning motor. The VFD's shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD's shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
l. VFDs must include ground shaft kit.
m. Standard operating conditions shall be:
    1) Incoming Power: Three-phase, 208 / 230 / 480 (+10% to -10%) and 50/60 Hz (+10 to -5%) power to a fixed potential DC bus level.
    2) Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.
    3) Speed regulation of +/- 0.5% of base speed.
    4) Load inertia dependent carryover (ride through) during utility loss.
    5) Insensitive to input line rotation.
    6) Humidity: 0 to 95% (non-condensing and non-corrosive).
    7) High Altitude: 1000 meters above sea level.
    8) Ambient Temperature: -10 to 40 □C (VT).
    9) Storage Temperature: -40 to 70 □C.
n. Control Features
    1) Keypad

i) Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not accepted, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.

ii) The VFD shall include a Hand-Off-Auto selection and an Inverter/Bypass selection. When in "Hand" the VFD will be started, and the speed will be controlled from the keypad. When in "Off", the VFD will be stopped. In "Auto", the VFD will start via an external contact closure or a communication network and the VFD speed will be controlled via an external speed reference.

iii) The keypad shall have copy / paste capability.

iv) Upon initial power up of the VFD, the keypad shall display a start-up guide that will sequence all the necessary parameter adjustments for general start up.

v) Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's USB port and Windows™ based software. In addition, the software shall permit control and monitoring via the VFD's RS485 port. The manufacturer shall supply the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18.

vi) The operator shall be able to scroll through the keypad menu to choose between the following:

1. Monitor
2. Parameters
3. Diagnostics
4. I/O and Hardware
5. User Settings
6. Favorites
7. Direct Access ID

2) The following setups and adjustments, at a minimum, are to be available:

i) Start command from keypad, remote and communications port.

ii) Speed command from keypad, remote and communications port.

iii) Motor direction selection

iv) Maximum and minimum speed limits

v) Acceleration and deceleration times, two settable ranges

vi) Critical (skip) frequency avoidance

vii) Torque limit

viii) Multiple attempts restart function.

ix) Multiple preset speeds adjustment

x) Catch a spinning motor start or normal start selection.

xi) Programmable analog output

3) Inputs/Outputs

i) Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs shall be provided with the following available as a minimum:

1. Remote HOA Hand/On/Off
2. Remote forward/reverse
3. Remote preset speeds
4. Remote external fault
5. Remote fault reset.
6. Process control speed reference interface, 4-20 mA DC
7. Potentiometer or process control speed reference interface, 0-10V DC
8. RS485 Programming and Operator Interface Port

ii) Outputs – A minimum of two (2) programmable form C Relay outputs, (1) programmable form A Relay output, and (1) programmable analog output shall be provided, with the following available at minimum.

iii) Programmable relay outputs selectable with the following available at minimum:

1. Fault
2. Run
3. Ready
4. Reversing
5. Preset Speed
6. At speed
7. Wrong Direction
8. Damper Control Relay
9. Over temperature Alarm

iv) Programmable analog output signal, selectable with the following available at minimum:

1. Output frequency
2. Frequency reference
3. Motor speed
4. Output current
5. Motor torque
6. Motor power
7. Motor voltage
8. DC link voltage
9. PID controller set point value.
10. PID controller output value
11. PID controller feedback value
12. PID controller error value

4) Capability of two additional expandable I/O interface cards. Upon installation, software shall automatically identify the interface card and activate the appropriate parameters. This should be done without adding any new software.

o. Monitoring and Displays

1) The VFD's display shall be a multi-line graphic type window capable of displaying nine lines of text and the following thirteen (13) status indicators:

i) Run
ii) Forward
iii) Reverse
iv) Stop
v) Ready
vi) Alarm
vii) Fault

viii) I/O Terminal
ix) Keypad
x) Fieldbus
xi) Hand
xii) Auto
xiii) Off

2) The VFD's keypad shall be capable of displaying the following monitoring functions at a minimum and be able to monitor any nine of them on a single screen:
i) Motor Speed (RPM and %)
ii) Analog Input 1
iii) Analog Input 2
iv) Output frequency
v) Motor current
vi) Motor torque
vii) Motor power (kW and %)
viii) Motor voltage
ix) DC-link voltage
x) Heat sink temperature.
xi) Motor temperature
xii) Run time hours (resettable)
xiii) Power on hours (resettable)
xiv) Total megawatt hours
xv) Megawatt hours (resettable)
xvi) Digital inputs status
xvii) Analog and relay outputs status
xviii) PID references

3) The VFD's keypad shall be able to measure in the following units:
i) Temperature in Fahrenheit
ii) Temperature in Celsius
iii) PSIG
iv) BAR
v) FEET
vi) Inches of Water Column
vii) Gallons per minute
viii) Feet per minute
ix) Cubic Feet per minute
x) Parts per Million
xi) %

p. Protective Functions
1) The VFD shall include the following protective features at minimum:
i) Overcurrent
ii) Overvoltage
iii) System fault
iv) Undervoltage
v) Input line supervision.
vi) Output phase supervision.
vii) Under temperature
viii) Overtemperature
ix) Motor stalled.
x) Motor over temperature
xi) Motor under load

2) The VFD shall provide ground fault protection during power-up, starting, and running. VFD's with no ground fault protection during running are not accepted.

q. Diagnostic Features
   1) Active Faults
      i) The last 10 faults shall be recorded and stored in sequential order.
      ii) Fault name and description of fault shall be displayed on the keypad.
      iii) Fault or alarm display shall blink.
      iv) Display drive data at time of fault (including date and time of occurrence)
      v) In the event several faults occur simultaneously, the sequence of active faults shall be viewable.
      vi) During a fault, the drive must be able to identify the following:
         1. Code
         2. ID
         3. State
         4. Date
         5. Time
         6. Operating Time
         7. Motor Current
         8. Output Frequency
         9. Output Voltage
         10. DC-Link Voltage
         11. Motor Control Status
         12. Motor Temperature
         13. Heat Sink Temperature
   2) Fault History
      i) The last 40 faults shall be recorded and stored in sequential order.
      ii) Display drive data (including date and time) at time of fault

r. Additional features included in the VFD's:
   1) The current withstand rating of the open VFD shall be 100,000 AIC.
   2) Built in communication capability options shall include BACnet/IP and shall have full communication with Cherry Creek School District's district wide network.
   3) The VFD shall have a cooling fan that is field replaceable using non-screw accessibility.
   4) VFD shall have conformal coated circuit boards for maximum protection of air quality conditions meeting IEC 60068-2-60 requirements. Chemical vapors IEC 60721-3-3, unit in operation class 3C3 and mechanical particles IEC 60721-3-3, unit in operation, class 3S2.
   5) VFD shall not use Electrolytic Capacitors within the power circuit and shall have a minimal maintenance free shelf life of no less than 5 years.
   6) VFD shall have an active (not static V/Hz curve) energy control algorithm to ensure maximum energy savings. VFD software shall include energy optimization algorithm. The software algorithm shall compare output voltage to the motor load. The output voltage is optimized to reduce the motor core losses and maintain a high enough voltage to prevent the motor from becoming unstable.

s. Enclosure
   1) The VFD may be designed in a NEMA Type 1, NEMA 12, or NEMA 3R enclosure. NEMA 4 rated for outdoor VFDs.
   2) The current withstand rating of the enclosed VFD shall be 65,000 AIC.

3) The VFD shall have complete front accessibility with easily removable assemblies.
4) Cable entry shall be top or bottom entry.

t. The VFD manufacturer representative shall provide a three-year warranty on all drives provided and shall maintain engineering service facilities within 75 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance, and training of customer personnel.

u. Refer to section 23.08.10 for approved manufacturer.

S. Emergency Power Off Switches

1. Manual EPO Switch, manual push button

a. Plastic cover required, no break glass.

b. Must be manually reset.

PART 3 - EXECUTION

A. SECTION INCLUDES
   1. Examination
   2. Coordination
   3. Field Quality Control
   4. Wiring
   5. Communication Wiring
   6. Fiber Optic Cable
   7. Installation of Sensors seal conduit that runs pressure like to exterior of Bldg or at AHU/panel
   8. Flow Switch Installation
   9. Actuators
   10. Variable Frequency Drives
   11. Control Panels/Enclosures
   12. Warning Labels
   13. Identification of Hardware and Wiring
   14. Control System Checkout and Testing
   15. Control System Demonstration and Acceptance
   16. Training
   17. Points List
   18. Sequences of Operation

B. EXAMINATION
   1. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
   2. The System Integrator shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.
   3. The System Integrator shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the System Integrator's work, and the plans and the work of others — the System Integrator shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the System Integrator's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the System Integrator to report such discrepancies shall be made by and at the expense of, this System Integrator.

C. COORDINATION
   1. Site
      a. Where the mechanical work will be installed in close proximity to or will interfere with work of other trades, the System Integrator shall assist in working out space conditions to make a satisfactory adjustment. If the System Integrator installs its work before coordinating with other trades, so as to cause any interference with work of other trades, the System Integrator shall make the necessary changes in its work to correct the condition without extra charge.
      b. Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress.
   2. Submittals. Refer to the "Submittals" Section in Part 1 of this specification for requirements.
   3. Test and Balance

a. The System Integrator shall furnish hardware, software, or application tools necessary to interface to the control system for test and balance purposes only.
b. The System Integrator shall provide training in the use of these tools. SI will be available to TAB for assistance as required.
c. In addition, the System Integrator shall provide a qualified technician to assist in the test and balance process until the first four (4) flow devices to be balanced.
d. The tools used during the test and balance process shall be returned to the System Integrator at the completion of the testing and balancing.

4. Life Safety
   a. Duct smoke detectors required for air handler shutdown are supplied under Division 26. The System Integrator shall interlock smoke detectors to air handlers for shutdown as described in Part 3: "Sequences of Operation".
   b. Smoke dampers and actuators required for duct smoke isolation are provided under another Division 25 Section. The System Integrator shall interlock these dampers to the air handlers as described in Part 3: "Sequences of Operation".
   c. Fire/smoke dampers and actuators required for fire rated walls are provided under another Division 25 Section. Control of these dampers shall be by Division 26. The System Integrator shall provide control air to the dampers.
5. Coordination with controls specified in other sections or divisions: Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the System Integrator as follows:
   a. All communication media and equipment shall be provided as specified in Part 2: "Communication" of this specification.
   b. Each supplier of a control's product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
   c. The System Integrator shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions of this specification.
   d. The System Integrator is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
   e. The System Integrator is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

D. FIELD QUALITY CONTROL
1. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification.
2. System Integrator shall continually monitor the field installation for code compliance, Cherry Creek School District standards and quality of workmanship.

E. WIRING
1. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.

2. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 26 requirements.
3. All low-voltage wiring shall meet NEC Class 2 requirements and shall be color coded per Part 2 of this specification. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
4. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
5. All wiring in mechanical, electrical, or service rooms, or where subject to mechanical damage, shall be installed in raceway minimum of ¾" at levels below 3m [10ft].
6. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
7. Do not install wiring in raceway containing tubing.
8. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 3m [10ft] intervals.
9. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
10. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
11. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
12. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the System Integrator shall provide step-down transformers.
13. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
14. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
15. Size of raceway and size and type of wire shall be the responsibility of the System Integrator, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.
16. Include one pull string in each raceway 2.5 cm [1"] or larger.
17. Use coded conductors throughout with different-colored conductors per Part 2 of this specification.
18. Control and status relays are to be in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
19. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15cm [6"] from high-temperature equipment (e.g., steam pipes or flues).
20. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
21. Adhere to Division 26 requirements where raceway crosses building expansion joints.

22. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
23. Wire installed through ribbed penetrations must be contained in conduit.
24. In insulated areas, wire must be installed in conduit.
25. The System Integrator shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
26. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m [3 ft] in length and shall be supported at each end. Flexible metal raceway less than ½" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
27. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.
28. Any conduit 1" or greater requires as built documentation.

F. COMMUNICATION WIRING
1. The System Integrator shall adhere to the items listed in the "Wiring" Section in Part 3 of the specification.
2. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
3. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
4. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.
5. System Integrator shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
6. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
7. All runs of communication wiring shall be unspliced length when that length is commercially available.
8. All communication wiring shall be labeled to indicate origination and destination data.
9. Grounding of coaxial cable shall be in accordance with NEC regulations Section on Communications Circuits, Cable, and Protector Grounding.

G. FIBER OPTIC CABLE
1. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications.
2. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
3. All fiber optic cable shall be labeled to indicate origination and destination data.

H. INSTALLATION OF SENSORS
1. Install sensors in accordance with the manufacturer's recommendations and shall be labeled to indicate origination, destination data, point name and address.
2. Mount sensors rigidly and adequately for the environment within which the sensor operates.

3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
5. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip.
6. Low limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m² [1 ft of sensing element for each 1 ft²] of coil area.
7. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
8. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
9. Differential air static pressure. Add: duct pressure tubing that goes onto roof needs to be sealed
    a. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable), or to the location of the duct high-pressure tap and leave open to the plenum.
    b. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
    c. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a Bldg static plate.
    d. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer. Rubber caps not acceptable; use nylon.
    e. All pressure transducers, other than those controlling VAV boxes, shall be in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
    f. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.
10. All sensors must be installed and accessible for future service, repair, or replacement.

I. FLOW SWITCH INSTALLATION
1. Use correct paddle for pipe diameter.
2. Adjust flow switch in accordance with manufacturer’s instructions; thread sealant as required by manufacturer's instructions.
3. Flow Switch shall be labeled to indicate origination, destination data, point name and address.

J. ACTUATORS
1. Mount and link control damper actuators per manufacturer's instructions.
    a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
c. Provide all mounting hardware and linkages for actuator installation.
d. Actuator shall be labeled to indicate origination, destination data, point name and address.
e. Shaft extensions shall be accessible for repair or replacement.

2. Electric/Electronic
a. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
b. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.
c. Valves shall be labeled to indicate origination, destination data, point name and address.

3. Pneumatic Actuators
a. Size pneumatic damper actuator to operate the related control damper(s) with sufficient reserve power to provide smooth modulating action or two-position action. Actuator also shall be sized for proper speed of response at the velocity and pressure conditions to which the control damper is subject.
b. Pneumatic damper actuators shall produce sufficient torque to close off against the maximum system pressures encountered. Size the pneumatic damper actuator to close off against the fan shutoff pressure, as a minimum.
c. Where two or more pneumatic damper actuators are installed for interrelated operation in unison, such as dampers used for mixing, provide the dampers with a positive pilot positioner. Positive pilot positioner shall be directly mounted to the pneumatic damper actuator and have pressure gauges for supply input and output pressures.
d. The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating. Provide at least one actuator for each damper section. Each damper actuator shall not power more than 2 m² [20 ft²] of damper.
e. Use line shafting or shaft couplings (jack shafting) in lieu of blade-to-blade linkages or shaft coupling when driving axially aligned damper sections.
f. Pneumatic actuators shall be labeled to indicate origination, destination data, point name and address.

K. VARIABLE FREQUENCY DRIVES
1. Bypass to be wired by CCSD.

L. CONTROL PANELS/ENCLOSURES
1. Local control panels:
a. Control panel shall be UL508A.
b. All indoor control cabinets shall be fully enclosed NEMA 1 construction with key-lock latch, removable sub-panels. A single key shall be common to all field panels and sub-panels.
c. Interconnections between internal and face-mounted devices pre-wired with color coded stranded conductors neatly installed in plastic troughs and/or tie wrapped. Terminals for field connections shall be UL Listed for 600-volt service, individually identified per control/interlock drawings, with adequate

clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

d. All enclosures to be keyed to CCSD specific standard.
e. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.
f. Control Panel shall be labeled to match control drawings.
g. Hard copy of as-builts provided in each enclosure.

M. WARNING LABELS

1. Permanent warning labels shall be affixed to all equipment which can be automatically started by the DDC system.
   a. Labels shall use white lettering (12-point type or larger) on a red background.
   b. Warning labels shall read as follows:

C A U T I O N
This equipment is operating under automatic control
And may start or stop at any time without warning.
Switch disconnect to the off position before servicing.

2. Permanent warning labels shall be affixed to all motor starters and all control panels which are connected to multiple power sources utilizing separate disconnects.
   a. Labels shall use white lettering (12-point type or larger) on a red background.
   b. Warning labels shall read as follows:

C A U T I O N
This equipment is fed from more than one
power source with separate disconnects.
Disconnect all power sources before servicing.

N. IDENTIFICATION OF HARDWARE AND WIRING

1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm [2"] of termination with the DDC address or termination number.
2. All pneumatic tubing shall be labeled at each end within 5 cm [2"] of termination with a descriptive identifier.
3. Permanently label or code each point of field terminal strips to show the instrument or item served.
4. Identify control panels with minimum 1 cm [½”] letters on laminated plastic nameplates.
5. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
6. Identify room sensors relating to terminal box or valves with nameplates.
7. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
8. Identifiers shall match record documents/ control drawings.

O. CONTROL SYSTEM CHECKOUT AND TESTING

1. Startup Testing: All testing listed in this section shall be performed by the System Integrator and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner’s Representative is notified of the system demonstration.

2. The System Integrator shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
3. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
4. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.
5. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
6. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start, and span are correct, and that direction and normal positions are correct. The System Integrator shall check all control valves and automatic dampers to ensure proper action and closure. The System Integrator shall make any necessary adjustments to valve stem and damper blade travel.
7. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
8. Alarms and Interlocks:
    a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
    b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
    c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
9. Trends
    a. Check each trend log separately for configuration and correctness.
    b. Check that each physical point is being trended.

P. CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE
1. Demonstration
    a. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the System Integrator has completed the installation, started up the system, and performed its own tests.
    b. The tests described in this section are to be performed in addition to the tests that the System Integrator performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Section in Part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
    c. The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
    d. The System Integrator shall provide at least two persons equipped with two way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the

proper operation shall be provided by and operated by the System Integrator.

e. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
f. Demonstrate compliance with Part 1: "System Performance."
g. Demonstrate compliance with Sequences of Operation through all modes of operation.
h. Demonstrate complete operation of operator interface.
i. Additionally, the following items shall be demonstrated:
    1) DDC Loop Response: The System Integrator shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the System Integrator.
    2) Optimum Start/Stop: The System Integrator shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started-and-stopped equipment, as well as temperature sensor inputs of affected areas.
    3) Interface to the building fire alarm system where BACnet interface is available.
    4) Operational/trend logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer/Cherry Creek School District personnel. These logs shall cover three 48-hour periods and have a sample frequency shall be by change of value and/or time based on not more than 10 minutes. How do I correct Aaron's English to make this make sense
j. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The System Integrator shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

2. Acceptance
    a. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the System Integrator may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.
    b. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: "Submittals."

Q. TRAINING
1. Provide a minimum of two on-site or classroom training sessions, two 4-hour days each, throughout the contract period for personnel designated by Cherry Creek School District.

2. Provide two additional training sessions at 6- and 12-months following building's turnover. Each session shall be four hours in length and must be coordinated with Cherry Creek School District.
3. Train the designated staff of Cherry Creek School District Representative to enable them to provide the following:
    a. Day-to-day Operators:
        1) Proficiently operate the system
        2) Understand control system architecture and configuration.
        3) Understand DDC system components.
        4) Understand system operation, including DDC system control and optimizing routines (algorithms)
        5) Operate the workstation and peripherals.
        6) Log on and off the system.
        7) Access graphics, point reports, and logs.
        8) Adjust and change system set points, time schedules, and holiday schedules.
        9) Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
        10) Understand system drawings, and Operation and Maintenance manual.
        11) Understand the job layout and location of control components.
        12) Access data from DDC controllers and ASCs
        13) Operate portable operator's terminals.
    b. Advanced Operators:
        1) Make and change graphics on the work station.
        2) Create, delete, and modify alarms, including annunciation and routing of these.
        3) Create, delete, and modify point trend logs, and graph or print these both on an ad-hoc basis and at user-definable time intervals.
        4) Create, delete, and modify reports.
        5) Add, remove, and modify system's physical points.
        6) Create, modify, and delete programming.
        7) Add panels when required.
        8) Add operator interface stations.
        9) Create, delete, and modify system displays — both graphical and otherwise
        10) Perform DDC system field checkout procedures.
        11) Perform DDC controller unit operation and maintenance procedures.
        12) Perform workstation and peripheral operation and maintenance procedures.
        13) Perform DDC system diagnostic procedures.
        14) Configure hardware including PC boards, switches, communication, and I/O points.
        15) Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
        16) Adjust, calibrate, and replace system components.
    c. System Managers/Administrators:
        1) Maintain software and prepare backups.
        2) Interface with job-specific, third-party operator software
        3) Add new users and understand password security procedures.
4. These objectives will be divided into three logical groupings. Participants may attend one or more of these, depending on level of knowledge required:
    a. Day-to-day Operators: parts 1-13
    b. Advanced Operators: parts 1-29
    c. System Managers/Administrators: parts 1-13, and 30-32

5. System Integrator shall provide course outline and materials as per "Submittals" Section in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.
6. The instructor(s) shall be factory-trained and Master Certified instructors experienced in presenting this material.
7. Classroom training shall be done using a network of simulators of working controllers' representative of the installed hardware. Each simulator shall have as a minimum an eBMGR, touch screen, room sensor(s), and application controller with a damper actuator.

R. POINT LIST
1. A points list will be provided for each equipment and/or system to be controlled and/or monitored identified on the construction drawings.

S. SEQUENCE OF OPERATIONS
1. [Provide operation as shown on drawings].

SECTION 23 09 93

SEQUENCES OF OPERATIONS FOR HVAC

PART 1 – GENERAL

A. OVERVIEW

1. This section has been provided as an outline for CCSD standards for the control of mechanical systems. It is the intent of this section to be utilized as a template for temperature control sequences of operation. These sequences shall be utilized to the greatest extent possible, as they apply to individual equipment and system types. Deviation from these sequences of operation shall be reviewed by the District prior to submittal of final construction documents. Items identified with [ ] indicate options to be reviewed and selected.
2. Sections of these guidelines include specific specification requirements in addition to design requirements. The Consulting Engineer shall review these guidelines and incorporate specific specification requirements as needed to meet specific project requirements.
3. The temperature controls for the project shall be assigned by CCSD to the contractor. Consultant shall ensure documentation for temperature controls is identified as being assigned to the contractor by the owner.

B. INTENT
1. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

C. SUBMITTALS GENERAL
1. Consultant shall pay particular attention to the submittals and O&M Manual requirements. In addition to O&M manual data, provide all temperature controls data, including controls components, sequences of operations, control diagrams, and points lists.

D. SUBMITTAL REQUIREMENTS
1. The following requirements shall be included within the project specifications as minimum requirements for temperature controls submittals. Consultant shall ensure these requirements are included within the project manual and associated submittals.
2. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
    a. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components, and function
    b. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
    c. Include at least the following sequences:
        1. Start-up.
        2. Warm-up mode.
        3. Normal operating mode.
        4. Unoccupied mode.
        5. Shutdown.
        6. Capacity control sequences and equipment staging.
        7. Temperature and pressure control, such as setbacks, setups, resets, etc.
        8. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
        9. Effects of power or equipment failure with all standby component functions.
        10. Sequences for all alarms and emergency shut downs.

11. Seasonal operational differences and recommendations.
12. Interactions and interlocks with other systems.

d. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
e. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
f. Include schedules, if known

3. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
   a. Label with settings, adjustable range of control and limits.
   b. Include flow diagrams for each control system, graphically depicting control logic.
   c. Include the system and component layout of all equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.
   d. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
   e. Include all monitoring, control and virtual points specified in elsewhere.
   f. Include a key to all abbreviations.
4. Points List: Submit list of all control points indicating at least the following for each point.
   a. Name of controlled system.
   b. Point abbreviation.
   c. Point description; such as dry bulb temperature, airflow, etc.
   d. Display unit.
   e. Control point or setpoint (Yes / No); i.e., a point that controls equipment and can have its setpoint changed.
   f. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
   g. Intermediate point (Yes / No); i.e., a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
   h. Calculated point (Yes / No); i.e., a “virtual” point generated from calculations of other point values.
5. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

PART 2 – NOT USED

PART 3 – EXECUTION

A. CENTRAL REFRIGERATION SYSTEM(S) SEQUENCES OF OPERATION (SINGLE AIR-COOLED CHILLER)
   1. Description
      a. Chilled water system consists of a single air-cooled chiller and [one][two] variable volume chilled water pumps.
      b. Chilled water coil valves in the system are both 2-way and 3-way valves. 3-way valves utilized to establish minimum system flow. Minimum system flow shall not be set below manufacturer’s minimum chiller flow.
   2. General:
      a. The DDC control system shall interface with manufacturer's chiller control panel. The Control Contractor shall be responsible for all low voltage control wiring associated with

the chiller. The chiller control panel shall provide control over the chillers leaving water temperature based on optimum chiller performance and chilled water reset temperature.

b. Provide temperature sensors for the outdoor air (with sun shield) and for the chilled water supply and return lines (with immersion wells).

3. System Operation:
   a. Above 65 Degrees F (adj.) the chiller system shall be enabled. Whenever the outside air temperature is below 65 Degrees F (adj.) the chiller system shall be disabled.
   b. Chilled water pump(s) shall run whenever chiller system is enabled.
   c. Chiller operates on internal controls to maintain chilled water set-point.
   d. [Provide chilled water reset to reset the chilled water supply temperature according to the highest demand. Greatest cooling demand shall be determined utilizing valve position. The valve which is open the greatest shall be considered the highest demand.]
   e. [Provide an automatic primary/standby control and fail over function for the chilled water pumps. The primary function of each pump shall be based on a calendar month rotation. When the chilled water pumps are rotated the chiller shall de-energize for a period of 5 minutes (adjustable) prior to actual pump rotation and then re-enable the chiller start circuit only after flow has been proven for the rotated pump. The designated lead pump shall run for a period of 5 minutes after the chiller has cycled off. Provide for start/stop control and positive run indication for each chilled water pump. System pumps shall run for a period of 5 minutes (adjustable) after chilled system is shut down.]
   f. The chilled water system primary pumps shall utilize variable frequency controllers to modulate chilled water system water flow. The VFD's will operate to maintain a designated pressure delta in the chilled water system. The pump's designated pressure delta shall be determined by the amount of water flow required to maintain proper flow across the last coil located the furthest distance from the pumping system. The pressure delta shall be capable of accommodating full flow through this last coil.
4. Operator Station Display:
   a. DDC system graphic.
   b. DDC system status, on-off.
   c. Outdoor-air temperature.
   d. Chilled-water supply temperature
   e. Chilled-water supply temperature set point.
   f. Chilled water return temperature.
   g. Chilled water loop differential pressure.
   h. Chilled water loop differential pressure set point.
   i. Chilled-water pump(s) on-off status.
   j. Chilled-water pump(s) on-off indication.
   k. Chiller General Failure Alarm.
   l. Chiller Status, on-off
   m. CW pump(s) CSR alarm.
   n. CW pump(s) VFD speed.
   o. CW pump(s) VFD enable.
   p. CW pump(s) VFD status/alarm.
   q. Low glycol level alarm

B. CENTRAL REFRIGERATION SYSTEM(S) SEQUENCES OF OPERATION (DUAL AIR-COOLED CHILLERS)
1. Description
   a. Chilled water system consists of a [two][number] air cooled chillers [of equal][of un-equal] size. The chilled water system is configured as a primary/secondary system.
   b. [A single constant volume primary chilled water pump for each chiller][Two constant volume primary pumps each sized for its associated chiller]
   c. [One][Two] variable volume secondary chilled water pumps

d. Chilled water coil valves in the system are both 2-way and 3-way valves. 3-way valves utilized to establish minimum system flow. Minimum system flow shall not be set below manufacturer's minimum chiller flow.
e. Each chiller shall include a motorized isolation valve on the chilled water side to isolate the disabled chiller.

2. General:
   a. The DDC control system shall interface with manufacturer's chiller control panel. The Control Contractor shall be responsible for all low voltage control wiring associated with the chiller. The chiller control panel shall provide control over the chillers leaving water temperature based on optimum chiller performance and chilled water reset temperature.
   b. Provide temperature sensors for the outdoor air (with sun shield) and for the chilled water supply and return lines (with immersion wells).
3. System Operation:
   a. Above 65 Degrees F (adj.) the chiller system shall be enabled. Whenever the outside air temperature is below 65 Degrees F (adj.) the chiller system shall be disabled.
   b. Chilled water primary pump(s) shall run whenever their associated chiller is enabled.
   c. Chilled water secondary pump(s) shall run whenever chilled water system is enabled.
   d. Chiller operates on internal controls to maintain chilled water set-point.
   e. [System monitors chiller capacity from chiller control panel. When lead chiller reaches 95% of total capacity (adjustable), enable second chiller. Chillers shall operate on their internal controls to maintain leaving water setpoint. Whenever chiller capacity of both operating chillers is 45% of total plant capacity, disable lag chiller.]
   f. [System starts smallest chiller first. System monitors chiller capacity from the chiller control panel. When chiller capacity reaches 95% of chiller capacity, system enables larger chiller and disables smaller chiller. Smaller chiller shall run for 5-min (adjustable) after larger chiller is enabled. When larger chiller capacity reaches 95% of chiller capacity, the smaller chiller is enabled and both chillers operate. When total system capacity 90% of either chiller sequence is reversed for chiller shut down.]
   g. [Provide chilled water reset to reset the chilled water supply temperature according to the highest demand. Greatest cooling demand shall be determined utilizing valve position. The valve which is open the greatest shall be considered the highest demand.]
   h. [Provide an automatic lead/lag control and fail over function for the chillers. The primary function of each chiller shall be based on a calendar month rotation. When the chillers are rotated the chiller shall de-energize for a period of 5 minutes (adjustable) prior to actual chiller rotation and then re-enable the chiller start circuit only after flow has been proven for the associated pump. Provide for start/stop control and positive run indication for each chiller.
   i. [Provide an automatic primary/standby control and fail over function for the chilled water pumps. The primary function of each pump shall be based on a calendar month rotation. When the chilled water pumps are rotated the chiller shall de-energize for a period of 5 minutes (adjustable) prior to actual pump rotation and then re-enable the chiller start circuit only after flow has been proven for the rotated pump. The designated lead pump shall run for a period of 5 minutes after the chiller has cycled off. Provide for start/stop control and positive run indication for each chilled water pump. System pumps shall run for a period of 5 minutes (adjustable) after chilled system is shut down.]
   j. The chilled water system primary pumps shall utilize variable frequency controllers to modulate chilled water system water flow. The VFD's will operate to maintain a designated pressure delta in the chilled water system. The pump's designated pressure delta shall be determined by the amount of water flow required to maintain proper flow across the last coil located the furthest distance from the pumping system. The pressure delta shall be capable of accommodating full flow through this last coil.
4. Operator Station Display:

a. DDC system graphic.
b. DDC system status, on-off.
c. Outdoor-air temperature.
d. Chilled-water supply temperature
e. Chilled-water supply temperature set point.
f. Chilled-water return temperature.
g. Chilled water loop differential pressure.
h. Chilled water loop differential pressure set point.
i. Chilled-water pump(s) on-off status.
j. Chilled-water pump(s) on-off indication.
k. Chiller General Failure Alarm.
l. Chiller Status, on-off
m. Chiller Load
n. Chilled Water Plant Load
o. CW pump(s) CSR alarm.
p. CW pump(s) VFD speed.
q. CW pump(s) VFD enable.
r. CW pump(s) VFD status/alarm.
s. Low glycol level alarm

C. CENTRAL REFRIGERATION SYSTEM(S) SEQUENCES OF OPERATION (SINGLE WATER-COOLED CHILLER)
1. Description
a. Chilled water system consists of a single water-cooled chiller, cooling tower, [condenser water sump tank,] [cooling tower bypass valve,] [condenser water system sand filter] [one][two] variable volume chilled water pumps, and [one][two] condenser water pumps.
b. Chilled water coil valves in the system are both 2-way and 3-way valves. 3-way valves utilized to establish minimum system flow. Minimum system flow shall not be set below manufacturer’s minimum chiller flow.
2. General:
a. The DDC control system shall interface with manufacturer's chiller control panel. The Control Contractor shall be responsible for all low voltage control wiring associated with the chiller. The chiller control panel shall provide control over the chillers leaving water temperature based on optimum chiller performance and chilled water reset temperature.
b. Provide temperature sensors for the outdoor air (with sun shield) and for the chilled water supply and return lines (with immersion wells).
3. System Operation:
a. Above 65 Degrees F (adj.) the chiller system shall be enabled. Whenever the outside air temperature is below 65 Degrees F (adj.) the chiller system shall be disabled.
b. Chilled water pump(s) shall run whenever chiller system is enabled.
c. Cooling tower shall be enabled whenever chiller system is enabled.
d. Chiller operates on internal controls to maintain chilled water set-point.
e. [System monitors chiller capacity from chiller control panel. When lead chiller reaches 95% of total capacity (adjustable), enable second chiller. Chillers shall operate on their internal controls to maintain leaving water setpoint. Whenever chiller capacity of both operating chillers is 45% of total plant capacity, disable lag chiller.]
f. [System starts smallest chiller first. System monitors chiller capacity from the chiller control panel. When chiller capacity reaches 95% of chiller capacity, system enables larger chiller and disables smaller chiller. Smaller chiller shall run for 5-min (adjustable) after larger chiller is enabled. When larger chiller capacity reaches 95% of chiller capacity, the smaller chiller is enabled and both chillers operate. When total system capacity 90% of either chiller sequence is reversed for chiller shut down.]

g. [Provide chilled water reset to reset the chilled water supply temperature according to the highest demand. Greatest cooling demand shall be determined utilizing valve position. The valve which is open the greatest shall be considered the highest demand.]
h. Tower Control
    1. Modulate cooing tower fan VFD to maintain condenser water temperature setpoint.
    2. Whenever tower supply water temperature falls below chiller manufacture's minimum chilled water setpoint, modulate tower bypass valve to bypass the tower and maintain minimum condenser water temperature.
    3. Provide automatic tower drain valve to drain cooling tower sump and return water piping whenever outside air temperature falls below 40 deg F. (adjustable).
    4. Condenser water make-up is controlled from [tower][sump tank] water level controls. System monitors condenser water make-up water.
i. Chiller Room Ventilation: The chiller room exhaust fan shall operate whenever space temperature exceeds 85 deg. F. BAS shall monitor fan operation and initiate an alarm for fan failure. Open machine room intake louver whenever exhaust fan operates.
j. Emergency Ventilation: Whenever a leak is detected from the refrigerant monitoring system, open chiller room intake louver. Chiller room exhaust fan shall operate at maximum speed.
k. [Provide an automatic primary/standby control and fail over function for the chilled water pumps. The primary function of each pump shall be based on a calendar month rotation. When the chilled water pumps are rotated the chiller shall de-energize for a period of 5 minutes (adjustable) prior to actual pump rotation and then re-enable the chiller start circuit only after flow has been proven for the rotated pump. The designated lead pump shall run for a period of 5 minutes after the chiller has cycled off. Provide for start/stop control and positive run indication for each chilled water pump. System pumps shall run for a period of 5 minutes (adjustable) after chilled system is shut down.]
l. The chilled water system primary pumps shall utilize variable frequency controllers to modulate chilled water system water flow. The VFD's will operate to maintain a designated pressure delta in the chilled water system. The pump's designated pressure delta shall be determined by the amount of water flow required to maintain proper flow across the last coil located the furthest distance from the pumping system. The pressure delta shall be capable of accommodating full flow through this last coil.
m. Sand Filter Operation: BAS shall enable the sand filter based on weekly (adjustable) time schedule.

4. Safeties:
    a. Emergency EPO switches, located where shown on the mechanical drawings, shall be provided, installed, and wired by the Controls Contractor. The Control Contractor shall provide and wire the low voltage wiring for chiller system control. The EPO switches shall be wired through the BAS system to de-energize the [chiller compressor circuit][all electrically operated equipment within the machine room] and annunciate an alarm at the district Workstation when manually activated. EPO switch shall be low voltage type switch.
    b. BAS shall monitor the refrigerant monitoring system as indicated on the mechanical drawings. Upon activation of the refrigerant monitoring system indicating a refrigerant leak, BAS shall generate an alarm to the district workstation. The BAS shall initiate emergency chiller room exhaust fan control.
5. Operator Station Display:
    a. DDC system graphic.
    b. DDC system status, on-off.
    c. Outdoor-air temperature.
    d. Chilled-water supply temperature
    e. Chilled-water supply temperature set point.

f. Chilled-water return temperature.
g. Chilled water loop differential pressure.
h. Chilled water loop differential pressure set point.
i. Chilled-water pump(s) on-off status.
j. Chilled-water pump(s) on-off indication.
k. Condenser water return temperature.
l. Condenser water supply temperature
m. Cooling tower supply temperature.
n. Cooling tower VFD alarm
o. Cooling tower fan CSR alarm
p. Cooling tower VFD speed
q. Cooling tower fan enable/disable.
r. Sand filter enable/disable.
s. Chiller room space temperature setpoint
t. Chiller room space temperature adjustment
u. Chiller room intake louver open/close
v. Chiller room exhaust fan enable/disable.
w. Chiller room fan emergency high speed enable/disable.
x. Refrigerant detection system alarm
y. Chiller room EPO alarm.
z. Chiller General Failure Alarm.
aa. Chiller Status, on-off
bb. CW pump(s) CSR alarm.
cc. CW pump(s) VFD speed.
dd. CW pump(s) VFD enable.
ee. CW pump(s) VFD status/alarm.
ff. Low glycol level alarm

D. CENTRAL REFRIGERATION SYSTEM(S) SEQUENCES OF OPERATION (DUAL WATER-COOLED CHILLERS)
1. Description
a. Chilled water system consists of multiple water-cooled chillers, [one][two] cooling towers, [condenser water sump tank(s),] [cooling tower bypass valve,] [condenser water system sand filter] [one][two] variable volume chilled water pumps, and [one][two] condenser water pumps.
b. Chilled water coil valves in the system are both 2-way and 3-way valves. 3-way valves utilized to establish minimum system flow. Minimum system flow shall not be set below manufacturer’s minimum chiller flow.
2. General:
a. The DDC control system shall interface with manufacturer's chiller control panel. The Control Contractor shall be responsible for all low voltage control wiring associated with the chiller. The chiller control panel shall provide control over the chillers leaving water temperature based on optimum chiller performance and chilled water reset temperature.
b. Provide temperature sensors for the outdoor air (with sun shield) and for the chilled water supply and return lines (with immersion wells).
3. System Operation:
a. Above 65 Degrees F (adj.) the chiller system shall be enabled. Whenever the outside air temperature is below 65 Degrees F (adj.) the chiller system shall be disabled.
b. Chilled water pump(s) shall run whenever chiller system is enabled.
c. Cooling tower shall be enabled whenever chiller system is enabled.
d. Chiller operates on internal controls to maintain chilled water set-point.
e. [Provide chilled water reset to reset the chilled water supply temperature according to the highest demand. Greatest cooling demand shall be determined utilizing valve position. The valve which is open the greatest shall be considered the highest demand.]

f. Tower Control
    1. Modulate cooing tower fan VFD to maintain condenser water temperature setpoint.
    2. Whenever tower supply water temperature falls below chiller manufacture's minimum chilled water setpoint, modulate tower bypass valve to bypass the tower and maintain minimum condenser water temperature.
    3. Provide automatic tower drain valve to drain cooling tower sump and return water piping whenever outside air temperature falls below 40 deg F. (adjustable).
    4. Condenser water make-up is controlled from [tower][sump tank] water level controls. System monitors condenser water make-up water.

g. Chiller Room Ventilation: The chiller room exhaust fan shall operate whenever space temperature exceeds 85 deg. F. BAS shall monitor fan operation and initiate an alarm for fan failure. Open machine room intake louver whenever exhaust fan operates.

h. Emergency Ventilation: Whenever a leak is detected from the refrigerant monitoring system, open chiller room intake louver. Chiller room exhaust fan shall operate at maximum speed.

i. [Provide an automatic primary/standby control and fail over function for the chilled water pumps. The primary function of each pump shall be based on a calendar month rotation. When the chilled water pumps are rotated the chiller shall de-energize for a period of 5 minutes (adjustable) prior to actual pump rotation and then re-enable the chiller start circuit only after flow has been proven for the rotated pump. The designated lead pump shall run for a period of 5 minutes after the chiller has cycled off. Provide for start/stop control and positive run indication for each chilled water pump. System pumps shall run for a period of 5 minutes (adjustable) after chilled system is shut down.]

j. The chilled water system primary pumps shall utilize variable frequency controllers to modulate chilled water system water flow. The VFD's will operate to maintain a designated pressure delta in the chilled water system. The pump's designated pressure delta shall be determined by the amount of water flow required to maintain proper flow across the last coil located the furthest distance from the pumping system. The pressure delta shall be capable of accommodating full flow through this last coil.

k. Sand Filter Operation: BAS shall enable the sand filter based on weekly (adjustable) time schedule.

4. Safeties:
    a. Emergency EPO switches, located where shown on the mechanical drawings, shall be provided, installed, and wired by the Controls Contractor. The Control Contractor shall provide and wire the low voltage wiring for chiller system control. The EPO switches shall be wired through the BAS system to de-energize the [chiller compressor circuit][all electrically operated equipment within the machine room] and annunciate an alarm at the district Workstation when manually activated. EPO switch shall be low voltage type switch.
    b. BAS shall monitor the refrigerant monitoring system as indicated on the mechanical drawings. Upon activation of the refrigerant monitoring system indicating a refrigerant leak, BAS shall generate an alarm to the district workstation. The BAS shall initiate emergency chiller room exhaust fan control.
5. Operator Station Display:
    a. DDC system graphic.
    b. DDC system status, on-off.
    c. Outdoor-air temperature.
    d. Chilled-water supply temperature
    e. Chilled-water supply temperature set point.
    f. Chilled-water return temperature.
    g. Chilled water loop differential pressure.
    h. Chilled water loop differential pressure set point.

i. Chilled-water pump(s) on-off status.
j. Chilled-water pump(s) on-off indication.
k. Condenser water return temperature.
l. Condenser water supply temperature
m. Cooling tower supply temperature.
n. Cooling tower VFD alarm
o. Cooling tower fan CSR alarm
p. Cooling tower VFD speed
q. Cooling tower fan enable/disable.
r. Sand filter enable/disable.
s. Chiller room space temperature setpoint
t. Chiller room space temperature adjustment
u. Chiller room intake louver open/close
v. Chiller room exhaust fan enable/disable.
w. Chiller room fan emergency high speed enable/disable.
x. Refrigerant detection system alarm
y. Chiller room EPO alarm.
z. Chiller General Failure Alarm.
aa. Chiller Status, on-off
bb. CW pump(s) CSR alarm.
cc. CW pump(s) VFD speed.
dd. CW pump(s) VFD enable.
ee. CW pump(s) VFD status/alarm.
ff. Low glycol level alarm

E. CENTRAL HEATING SYSTEMS(S) SEQUENCES OF OPERATION.
1. Description:
a. Hot water heating system consists of [two][three][number] condensing hot water boiler(s) and manufacturers boiler management system.
b. [two][number] variable volume primary heating water pumps with variable frequency drives.
c. The hot water coil valves in the system are both 2-way and 3-way valves. 3-way valves utilized to establish minimum system flow.
2. General:
a. The DDC control system shall interface with manufacturer's boiler management system. The Control Contractor shall be responsible for all low voltage control wiring associated with the hot water boilers. The boilers will be furnished with integral flame safe guard switches and low water cut-off switches, which are of the manual reset type. The boiler management system shall provide automatic lead-lag control functions over the boilers. The boiler management system shall also provide control over each boiler's heating water supply temperature based on optimum boiler performance and heating water reset schedule.
b. The boilers shall be provided with a Boiler Management system (BMS) with a mod bus interface. The BMS system shall be provided with specific boiler alarm status and the DDC system shall include specific alarm points through the BMS. See specification Section 23 52 16 for boiler control interface.
c. Provide temperature sensors for the outdoor air (with sun shield) and for the hot water supply and return lines (with immersion wells).
3. System Operation:
a. Above 65 Degrees F (adj.) the boilers shall remain de-energized. Below 65 Degrees F (adj.) the boiler system shall be enabled.
b. Provide an automatic primary/standby control and fail over function for the hot water pumps. The primary function of each pump shall be based on a calendar month rotation. When the hot water pumps are rotated the boiler shall de-energize for a period of 5

minutes (adjustable) prior to actual pump rotation and then re-enable the boiler start circuit only after flow has been proven for the rotated pump. The designated lead pump shall run for a period of 5 minutes after the boilers have cycled off. Provide for start/stop control and positive run indication for each hot water pump. System pumps shall run for a period of 5 minutes (adjustable) after boiler system is shut down.

c. The boilers and their pump shall run continuously after combustion air flow has been proven open by airflow sensors integral with each boiler.
d. [The BAS system will reset the building's heating water temperature, through the boiler management system, based on an inverse linear relationship based on outside air temperature. The reset schedule shall be:
    1. 0 Deg F – [180 Deg F][160 Deg F]
    2. 60 Deg F – 120 deg F, or manufacturer's minimum.]
e. The heating system primary pumps shall utilize variable frequency controllers to modulate heating system water flow. The VFD's will operate to maintain a designated pressure delta in the hot water heating system. The pump's designated pressure delta shall be determined by the amount of water flow required to maintain proper flow across the last coil located the furthest distance from the pumping system. The pressure delta shall be capable of accommodating full flow through this last coil.

4. Safeties:
    c. Emergency EPO switches, located where shown on the mechanical drawings, shall be provided, installed, and wired by the Controls Contractor. The Control Contractor shall provide and wire the low voltage wiring for boiler system control. The EPO switches shall be wired through the BAS system to de-energize the hot water heating system (boilers and domestic hot water heaters only) and annunciate an alarm at the district Workstation when manually activated. EPO switch shall be low voltage type switch.
5. Operator Station Display:
    a. DDC system graphic.
    b. DDC system status, on-off.
    c. Outdoor-air temperature.
    d. Heating-water supply temperature
    e. Heating-water supply temperature set point.
    f. Heating-water return temperature.
    g. Hot water loop differential pressure.
    h. Hot water loop differential pressure set point.
    i. Heating-water pump(s) on-off status.
    j. Heating-water pump(s) on-off indication.
    k. Boiler General Failure Alarm.
    l. HW pump(s) VFD speed.
    m. HW pump(s) VFD enable.
    n. HW pump(s) VFD status/alarm.
    o. HW pump(s) CSR alarm
    p. EPO alarm.

F. VAV AIR HANDLING UNIT SEQUENCE OF OPERATION
1. Description:
    a. The VAV air handling unit consists of the following system components:
        1. Variable volume supply air fan with VFD
        2. [Return air fan with VFD]
        3. [Unit relief/exhaust air fan with VFD]
        4. [Remotely located relief/exhaust air fan(s) with VFD]
        5. [Remotely located relief/exhaust air hood(s) with motorized dampers]
        6. Motorized return & outside air dampers
        7. [Hot water heating coil]

8. [Pumped hot water heating coil]
9. [Gas heating section]
10. [Chilled water-cooling coil]
11. [DX cooling coil]
12. Outside airflow monitoring station
13. Return air CO2 controls.
14. Duct static pressure controls.

2. General:
   a. The Control Contractor shall also provide DDC VAV terminal unit controllers, sensors, and hot water coil valves for all scheduled VAV terminal units.
   b. The Control Contractor shall connect each controller to the communication network, bind all applicable points, and program each air handling unit controller in accordance with the following sequences.
3. System Control:
   a. Supply Fan Control: Modulate fan speed to maintain duct static pressure setpoint as outlined below. Fan static pressure setpoint shall be determined as pressure required to maintain [1-inch w.c.][x-inch w.c.] at furthest box.
   b. Duct Static Pressure Control:
      1. The BMS shall measure duct static pressure and modulate the supply air fan VFD speed to maintain a duct static pressure setpoint. The speed shall not drop below 10% (adjustable). The static pressure setpoint shall be reset based on zone cooling/heating requirements.
      2. The BMS will modulate the supply air fan air volume to maintain supply air pressure setpoint. The BMS shall directly interface with the supply fan VFD. A duct static pressure sensor located in the supply air ductwork as indicated on the construction drawings. The final location shall be proposed by the TC and submitted to the engineer for final approval.
      3. The BMS monitors the damper position of all VAV terminal units to determine the critical zone (The VAV terminal unit that is the highest percentage open). The goal is to always maintain duct static pressure as low as possible. This is achieved by maintaining the critical zone between 85% and 95% open.
      4. When the critical zone is less than 85% open, the supply fan discharge static pressure resets downward by 0.10” (adjustable), from the previous setpoint, at a frequency of 10 minutes until the critical zone is more than 85% open.
      5. When the critical zone is more than 95% open, the supply fan discharge static pressure resets upward by 0.10” (adjustable), from the previous setpoint, at a frequency of 10 minutes until the critical zone is less than 95% open.
      6. The control bands, setpoint increment values, setpoint decrement values, and adjustment frequencies will be adjusted to optimize static pressure control for stable system operation.
      7. Design duct static pressure setpoint is 1.5”. To always satisfy all zones higher setpoints may be calculated by this routine. These conditions which cause higher setpoints shall be investigated and resolved to allow the system to operate at lower pressures. A maximum setpoint will be set so that a trouble zone will not drive the setpoint beyond a reasonable value. Maximum allowed static pressure is 1.75” (adjustable)
   c. [Return Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]
   d. [Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building

differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]

e. [Remote mounted Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]
f. [Relief Hood Control: Modulate relief air damper(s) to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings.]
g. Mixed-Air Control: Modulate OA and RA dampers to maintain minimum outside air setpoints as indicated on the equipment schedules in response to outside air airflow as measured from outside airflow monitoring station. CO2 may over-ride minimum airflow setpoints based on minimum/maximum CO2 levels.
h. [Demand Controlled Ventilation (DCV): DCV is enabled and disabled through the BAS. Enable DCV function whenever system is in occupied mode. When the DCV system is enabled the minimum outside air damper position shall be reset between the minimum outside air floor and ceiling positions to maintain the return air CO2 setpoint. The minimum outside air ventilation ceiling value is based on ASHRAE 62.1 calculations incorporating floor area and fully occupied space ventilation requirements. The minimum outside air floor value is based on the ASHRAE 62.1 calculation incorporating floor area ventilation requirements. Outside airflow rates shall be as determined from unit OSA airflow monitoring station. Outside airflow rates are defined as follows:
    1. Absolute CO2 Setpoint (PPM):
    2. Alarm CO2 Setpoint (PPM):
    3. Ventilation Floor Minimum (CFM):
    4. Ventilation Ceiling Minimum (CFM):

    Limit the maximum outside air damper position based on a mixed air temperature low limit of 45 degrees F. (adjustable). Economizer function overrides DCV functions. If CO2 levels exceed maximum CO2 level setpoints, system shall modulate OSA dampers open in 5% airflow increments at 10-minute intervals until CO2 levels drop below maximum setpoint.]
i. [CO2 Reset Mixing Dampers: The CO2 content in each classroom/office/space (as indicated on the construction drawings and its VAV damper position shall be monitored. As necessary, the air handling unit mixing dampers shall be overridden open, to additional outside air, to maintain CO2 levels in said space at required levels.]
j. Economizer: When conditions are favorable (outside air is less than return air), modulate OA and RA dampers to maintain discharge air temperature. When mixed air temperature exceeds SA setpoint enable cooling in conjunction with economizer.
k. [HW Heating Coil: Modulate hot water coil valve to maintain discharge air temperature setpoint.]
l. [Gas Heating Coil: Modulate gas valve to maintain discharge air temperature setpoint.]
m. [HW Coil Circulation Pump: Enable coil circulation pump whenever outside air temperatures are below 65 deg F (adjustable)].
n. [Chilled Water-Cooling Coil: Modulate chilled water coil valve to maintain discharge air temperature setpoint]
o. [DX Cooling Coil: Unit controls stage DX compressors, and [hot gas bypass][variable speed compressor] to maintain discharge air temperature setpoint.
p. Provide discharge air temperature reset based on average zones. Average demand to be determined by a polling of all zones by the BAS and deviation from setpoint.

4. Modes of Operation:
    a. The occupancy mode (occupied-unoccupied) shall be determined through a user-adjustable, graphical, seven-day schedule with an additional holiday schedule.

b. Occupied Mode:
    1. The supply fan shall run continuously.
    2. [Return fan shall run whenever the supply fan runs.]
    3. [Relief/Exhaust fan shall run whenever the supply fan runs.]
    4. [Remote mounted relief/exhaust fan shall run whenever the supply fan runs]
    5. [Relief air dampers shall be enabled whenever the supply fan runs]
    6. Outside air dampers shall be set to minimum position and enable mixed air and economizer functions.
    7. Unit operates as outlined above.
c. Unoccupied Mode:
    1. The supply fan shall be de-energized unless there is a call for heating or cooling in the system by any five (5) zones (adjustable), or if a single zone temperature deviates from temperature of greater than 5 degrees F (adjustable).
    2. [Return fan shall be de-energized. Fan shall only operate whenever supply fan operates as outlined above]
    3. [Relief/Exhaust fan shall be de-energized.]
    4. [Remote mounted relief/exhaust fan shall be de-energized]
    5. [Relief air dampers shall be closed]
    6. Both outdoor air dampers and exhaust dampers shall be closed. The return air damper shall be open.
    7. Unit heating and cooling coils operate as outlined above to maintain discharge air temperature setpoint.
d. Morning Warm-up:
    1. When the outside air temperature is below 55 degrees F, the DDC system shall perform a morning warm-up cycle prior to the occupied mode.
    2. The supply fan shall operate.
    3. [The return fan shall operate]
    4. [The relief/exhaust fan shall not operate]
    5. [The remote mounted relief/exhaust fan shall not operate]
    6. [The relief air dampers shall be closed]
    7. The outside air damper shall be closed, and the return air damper shall be open.
    8. Unit heating coil shall operate as outlined above to maintain discharge air temperature setpoint.
    9. Cooling shall be disabled.
    10. The Air Handling Unit shall remain in the morning warm-up mode until all zones are at their occupied space temperature setpoint. Once all zones are at occupied temperature, enable occupied mode.
e. Morning Cool-down:
    1. When the system is in cooling night setback, the DDC system shall perform a morning cool-down cycle prior to the occupied mode.
    2. If outside air temperature is below average space temperature:
        i. The supply fan shall operate.
        ii. [The return fan shall operate]
        iii. [The relief/exhaust fan shall operate]
        iv. [The remote mounted relief/exhaust fan shall operate]
        v. [The relief air dampers shall be open]
        vi. The outside air dampers shall open and return air damper shall close.
        vii. The cooling and heating systems shall be disabled.
    3. If the outside air temperature is above average space temperature:
        i. The supply fan shall operate.
        ii. [The return fan shall operate]
        iii. [The relief/exhaust fan shall not operate]

iv. [The remote mounted relief/exhaust fan shall not operate]
v. [The relief air dampers shall be closed]
vi. The outside air dampers shall close, and the return air damper shall open.
vii. The cooling system shall be enabled and operate as outlined above to maintain discharge air temperature setpoint.
viii. Heating system shall be disabled.

4. The Air Handling Unit shall remain in the morning cool-down mode until all zones are at their occupied space temperature setpoint. Once all zones are at occupied temperature, enable occupied mode.

5. Safety Interlocks and Overrides:
   a. Smoke Detectors: On the detection of smoke from a duct mounted smoke detector, a hard-wired interlock with the supply fan shall shut down the supply fan and [return fan][relief/exhaust fan][remote relief/exhaust fan(s)] through a signal to the VFD. The unit outside air and [unit relief][remote mounted relief] air dampers shall close. The smoke detector shall furnished and wired by electrical and installed by mechanical. The duct mounted smoke detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider.
   b. Freezestat located just downstream of the [HW coil][gas heating section] in the air handling unit shall cause the following, upon sensing a temperature less than 38 degrees F (adj.): The supply fan shall stop, [return fan][relief/exhaust fan][remote mounted relief fan] shall stop, all dampers shall close to outside air and the heating valve shall open to 100% or a programmed amount. An alarm shall be initiated to the BAS.
   c. Supply Air Low Limit: Discharge air temperature sensor shall initiate an alarm, close outside air dampers, and modulate [the hot water][gas heating] control valve upon if the supply air temperature drops below 45 degrees F. when unit is in heating mode. Function disabled during cooling mode. This has priority over the needs of discharge air and CO2 control loops.
   d. Duct Static Safety: A manual reset, high limit static pressure switch, located in the supply duct shall shut down the supply fan if it senses a static pressure above 2.5" (adj) WC. Initial high static pressure limit shall be set at 0.5” WC above scheduled external static pressure.
6. Monitor and Alarm Points: The value, binary state, setpoint, voltage, run hours, etc. of any input, output, control loop or virtual point shall be monitored on screen. Terminal mode group information screens shall be provided per the standards required by the District.
7. Operator Station Display:
   a. System occupied/unoccupied mode.
   b. Supply fan on/off indication.
   c. Supply fan current sensing relay alarm.
   d. Supply fan VFD alarm.
   e. Supply fan VFD speed indication.
   f. [Return fan on/off indication]
   g. [Return fan current sensing relay alarm]
   h. [Return fan VFD alarm]
   i. [Return fan VFD speed indication]
   j. [Relief/Exhaust fan on/off indication]
   k. [Relief/Exhaust fan current sensing relay alarm]
   l. [Relief/Exhaust fan VFD alarm]
   m. [Relief/Exhaust fan VFD speed indication]
   n. [Remote mounted Relief/Exhaust fan on/off indication]
   o. [Remote mounted Relief/Exhaust fan current sensing relay alarm]
   p. [Remote mounted Relief/Exhaust fan VFD alarm]
   q. [Remote mounted Relief/Exhaust fan VFD speed indication]

r. [Remote mounted relief hood damper position]
s. Outside air temperature indication
t. Mixed air temperature indication
u. Return air temperature indication.
v. Unit discharge air temperature indication.
w. [Chilled water control valve position]
x. [DX system Enable]
y. [Heating water control valve position]
z. [Gas heating control valve position]
aa. Freeze stat alarm.
bb. Smoke alarm
cc. Outside air setpoint
dd. Outside air indication
ee. Supply air discharge temperature control point adjustment.
ff. Supply static pressure indication.
gg. Supply static pressure control point adjustment.
hh. Building static pressure indication
ii. Building static pressure control point adjustment
jj. [HW coil circulation pump on/off indication]
kk. [HW coil circulation pump current sensing relay alarm]
ll. Unit CO2 level indication
mm. Unit CO2 level control point adjustment.

G. SINGLE ZONE VAV AIR HANDLING UNIT SEQUENCE OF OPERATION
1. Description:
a. The single zone VAV air handling unit is designed to operate as a single zone air handling unit with variable supply air volumes.
b. The single zone VAV air handling unit consists of the following system components:
1. Variable volume supply air fan with VFD
2. [Return air fan with VFD]
3. [Unit relief/exhaust air fan with VFD]
4. [Remotely located relief/exhaust air fan(s) with VFD]
5. [Remotely located relief/exhaust air hood(s) with motorized dampers]
6. Motorized return & outside air dampers
7. [Hot water heating coil]
8. [Pumped hot water heating coil]
9. [Gas heating section]
10. [Chilled water-cooling coil]
11. [DX cooling coil]
12. Outside airflow monitoring station
13. Return air CO2 controls.
2. General:
a. The Control Contractor shall connect each controller to the communication network, bind all applicable points, and program each air handling unit controller in accordance with the following sequences.
3. System Control:
a. Supply Fan Control: Fan shall run continuously during occupied periods. Fan cycles during unoccupied periods. Modulate supply air fan to maintain space temperature in conjunction with cooling and heating systems. Initial fan setpoint shall be 30% (adjustable) total supply air volume.
b. [Return Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential

pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]

c. [Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]
d. [Remote mounted Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]
e. [Relief Hood Control: Modulate relief air damper(s) to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings.]
f. Mixed-Air Control: Modulate OA and RA dampers to maintain minimum outside air setpoints as indicated on the equipment schedules in response to outside air airflow as measured from outside airflow monitoring station. CO2 may over-ride minimum airflow setpoints based on minimum/maximum CO2 levels.
q. [Demand Controlled Ventilation (DCV): DCV is enabled and disabled through the BAS. Enable DCV function whenever system is in occupied mode. When the DCV system is enabled the minimum outside air damper position shall be reset between the minimum outside air floor and ceiling positions to maintain the return air CO2 setpoint. The minimum outside air ventilation ceiling value is based on ASHRAE 62.1 calculations incorporating floor area and fully occupied space ventilation requirements. The minimum outside air floor value is based on the ASHRAE 62.1 calculation incorporating floor area ventilation requirements. Outside airflow rates shall be as determined from unit OSA airflow monitoring station. Outside airflow rates are defined as follows:
    1. Absolute CO2 Setpoint (PPM):
    2. Alarm CO2 Setpoint (PPM):
    3. Ventilation Floor Minimum (CFM):
    4. Ventilation Ceiling Minimum (CFM):

    Limit the maximum outside air damper position based on a mixed air temperature low limit of 45 degrees F. (adjustable). Economizer function overrides DCV functions. If CO2 levels exceed maximum CO2 level setpoints, system shall modulate OSA dampers open in 5% airflow increments at 10-minute intervals until CO2 levels drop below maximum setpoint.]
g. [CO2 Reset Mixing Dampers: The CO2 content in the space (as indicated on the construction drawings shall be monitored. As necessary, the air handling unit mixing dampers shall be overridden open, to additional outside air, to maintain CO2 levels in said space at required levels.]
h. Economizer: When conditions are favorable (outside air is less than return air), modulate OA and RA dampers to maintain discharge air temperature. When mixed air temperature exceeds SA setpoint enable cooling in conjunction with economizer.
i. [HW Heating Coil: Modulate hot water coil valve to maintain discharge air temperature setpoint.]
j. [Gas Heating Coil: Modulate gas valve to maintain discharge air temperature setpoint.]
k. [HW Coil Circulation Pump: Enable coil circulation pump whenever outside air temperatures are below 65 deg F (adjustable)].
l. [Chilled Water-Cooling Coil: Modulate chilled water coil valve to maintain discharge air temperature setpoint]
m. [DX Cooling Coil: Unit controls stage DX compressors, and [hot gas bypass][variable speed compressor] to maintain discharge air temperature setpoint.

n. Provide discharge air temperature reset based on space temperature to maintain space temperature setpoint.

4. Modes of Operation:
   a. The occupancy mode (occupied-unoccupied) shall be determined through a user-adjustable, graphical, seven-day schedule with an additional holiday schedule.
   b. Occupied Mode:
      1. The supply fan shall run continuously.
      2. [Return fan shall run whenever the supply fan runs.]
      3. [Relief/Exhaust fan shall run whenever the supply fan runs.]
      4. [Remote mounted relief/exhaust fan shall run whenever the supply fan runs]
      5. [Relief air dampers shall be enabled whenever the supply fan runs]
      6. Outside air dampers shall be set to minimum position and enable mixed air and economizer functions.
      7. Unit operates as outlined above.
   c. Unoccupied Mode:
      1. The supply fan shall be de-energized unless there is a call for heating or cooling in the space.
      2. [Return fan shall be de-energized. Fan shall only operate whenever supply fan operates as outlined above]
      3. [Relief/Exhaust fan shall be de-energized.]
      4. [Remote mounted relief/exhaust fan shall be de-energized]
      5. [Relief air dampers shall be closed]
      6. Both outdoor air dampers and exhaust dampers shall be closed. The return air damper shall be open.
      7. Unit heating and cooling coils operate as outlined above to maintain discharge air temperature setpoint.
   d. Morning Warm-up:
      1. When the outside air temperature is below 55 degrees F, the DDC system shall perform a morning warm-up cycle prior to the occupied mode.
      2. The supply fan shall operate.
      3. [The return fan shall operate]
      4. [The relief/exhaust fan shall not operate]
      5. [The remote mounted relief/exhaust fan shall not operate]
      6. [The relief air dampers shall be closed]
      7. The outside air damper shall be closed, and the return air damper shall be open.
      8. Unit heating coil shall operate as outlined above to maintain discharge air temperature setpoint.
      9. Cooling shall be disabled.
      10. The Air Handling Unit shall remain in the morning warm-up mode until space it at the occupied space temperature setpoint.
   e. Morning Cool-down:
      1. When the system is in cooling night setback, the DDC system shall perform a morning cool-down cycle prior to the occupied mode.
      2. If outside air temperature is below average space temperature:
         i. The supply fan shall operate.
         ii. [The return fan shall operate]
         iii. [The relief/exhaust fan shall operate]
         iv. [The remote mounted relief/exhaust fan shall operate]
         v. [The relief air dampers shall be open]
         vi. The outside air dampers shall open and return air damper shall close.
         vii. The cooling and heating systems shall be disabled.
      3. If the outside air temperature is above average space temperature:

i. The supply fan shall operate.
ii. [The return fan shall operate]
iii. [The relief/exhaust fan shall not operate]
iv. [The remote mounted relief/exhaust fan shall not operate]
v. [The relief air dampers shall be closed]
vi. The outside air dampers shall close, and the return air damper shall open.
vii. The cooling system shall be enabled and operate as outlined above to maintain discharge air temperature setpoint.
viii. Heating system shall be disabled.

4. The Air Handling Unit shall remain in the morning cool-down mode until space is at occupied space temperature setpoint.

5. Safety Interlocks and Overrides:
   a. Smoke Detectors: On the detection of smoke from a duct mounted smoke detector, a hard-wired interlock with the supply fan shall shut down the supply fan and [return fan][relief/exhaust fan][remote relief/exhaust fan(s)] through a signal to the VFD. The unit outside air and [unit relief][remote mounted relief] air dampers shall close. The smoke detector shall furnished and wired by electrical and installed by mechanical. The duct mounted smoke detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider.
   b. Freezestat: Freezestat located just downstream of the [HW coil][gas heating section] in the air handling unit shall cause the following, upon sensing a temperature less than 38 degrees F (adj.): The supply fan shall stop, [return fan][relief/exhaust fan][remote mounted relief fan] shall stop, all dampers shall close to outside air and the heating valve shall open to 100% or a programmed amount. An alarm shall be initiated to the BAS.
   c. Supply Air Low Limit: Discharge air temperature sensor shall initiate an alarm, close outside air dampers, and modulate [the hot water][gas heating] control valve upon if the supply air temperature drops below 45 degrees F. when unit is in heating mode. Function disabled during cooling mode. This has priority over the needs of discharge air and CO2 control loops.
   d. Duct Static Safety: A manual reset, high limit static pressure switch, located in the supply duct shall shut down the supply fan if it senses a static pressure above 2.5" (adj) WC. Initial high static pressure limit shall be set at 0.5” WC above scheduled external static pressure.
6. Monitor and Alarm Points: The value, binary state, setpoint, voltage, run hours, etc. of any input, output, control loop or virtual point shall be monitored on screen. Terminal mode group information screens shall be provided per the standards required by the District.
7. Operator Station Display:
   a. System occupied/unoccupied mode.
   b. Supply fan on/off indication.
   c. Supply fan current sensing relay alarm.
   d. Supply fan VFD alarm.
   e. Supply fan VFD speed indication.
   f. [Return fan on/off indication]
   g. [Return fan current sensing relay alarm]
   h. [Return fan VFD alarm]
   i. [Return fan VFD speed indication]
   j. [Relief/Exhaust fan on/off indication]
   k. [Relief/Exhaust fan current sensing relay alarm]
   l. [Relief/Exhaust fan VFD alarm]
   m. [Relief/Exhaust fan VFD speed indication]
   n. [Remote mounted Relief/Exhaust fan on/off indication]
   o. [Remote mounted Relief/Exhaust fan current sensing relay alarm]

p. [Remote mounted Relief/Exhaust fan VFD alarm]
q. [Remote mounted Relief/Exhaust fan VFD speed indication]
r. [Remote mounted relief hood damper position]
s. Outside air temperature indication
t. Mixed air temperature indication
u. Return air temperature indication.
v. Unit discharge air temperature indication.
w. [Chilled water control valve position]
x. [DX system Enable]
y. [Heating water control valve position]
z. [Gas heating control valve position]
aa. Freeze stat alarm.
bb. Smoke alarm
cc. Outside air setpoint
dd. Outside air indication
ee. Supply air discharge temperature control point adjustment.
ff. Building static pressure indication
gg. Building static pressure control point adjustment
hh. [HW coil circulation pump on/off indication]
ii. [HW coil circulation pump current sensing relay alarm]
jj. Unit CO2 level indication
kk. Unit CO2 level control point adjustment.

H. PACKAGED SINGLE ZONE AIR HANDLING UNIT SEQUENCE OF OPERATION
1. Description:
   a. The single zone air handling unit is designed to operate as a single zone air handling unit with constant supply air volumes.
   b. The single zone air handling unit consists of the following system components:
      1. Constant volume supply air fan
      2. [Unit relief/exhaust air fan with VFD]
      3. [Remotely located relief/exhaust air fan(s) with VFD]
      4. [Remotely located relief/exhaust air hood(s) with motorized dampers]
      5. Motorized return & outside air dampers
      6. [Hot water heating coil]
      7. [Pumped hot water heating coil]
      8. [Gas heating section]
      9. DX cooling coil
      10. Outside airflow monitoring station
      11. Return air CO2 controls.
2. General:
   a. The Control Contractor shall connect each controller to the communication network, bind all applicable points, and program each air handling unit controller in accordance with the following sequences.
3. System Control:
   a. Supply Fan Control: Fan shall run continuously during occupied periods. Fan cycles during unoccupied periods.
   b. [Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]
   c. [Remote mounted Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from

remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.]

d. [Relief Hood Control: Modulate relief air damper(s) to maintain building static pressure of 0.05 in w.c. (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings.]
e. Mixed-Air Control: Modulate OA and RA dampers to maintain minimum outside air setpoints as indicated on the equipment schedules in response to outside air airflow as measured from outside airflow monitoring station. CO2 may over-ride minimum airflow setpoints based on minimum/maximum CO2 levels.
r. [Demand Controlled Ventilation (DCV): DCV is enabled and disabled through the BAS. Enable DCV function whenever system is in occupied mode. When the DCV system is enabled the minimum outside air damper position shall be reset between the minimum outside air floor and ceiling positions to maintain the return air CO2 setpoint. The minimum outside air ventilation ceiling value is based on ASHRAE 62.1 calculations incorporating floor area and fully occupied space ventilation requirements. The minimum outside air floor value is based on the ASHRAE 62.1 calculation incorporating floor area ventilation requirements. Outside airflow rates shall be as determined from unit OSA airflow monitoring station. Outside airflow rates are defined as follows:
    1. Absolute CO2 Setpoint (PPM):
    2. Alarm CO2 Setpoint (PPM):
    3. Ventilation Floor Minimum (CFM):
    4. Ventilation Ceiling Minimum (CFM):

    Limit the maximum outside air damper position based on a mixed air temperature low limit of 45 degrees F. (adjustable). Economizer function overrides DCV functions. If CO2 levels exceed maximum CO2 level setpoints, system shall modulate OSA dampers open in 5% airflow increments at 10-minute intervals until CO2 levels drop below maximum setpoint.]
f. [CO2 Reset Mixing Dampers: The CO2 content in the space (as indicated on the construction drawings shall be monitored. As necessary, the air handling unit mixing dampers shall be overridden open, to additional outside air, to maintain CO2 levels in said space at required levels.]
g. Economizer: When conditions are favorable (outside air is less than return air), modulate OA and RA dampers to maintain discharge air temperature. When mixed air temperature exceeds SA setpoint enable cooling in conjunction with economizer.
h. [HW Heating Coil: Modulate hot water coil valve to maintain discharge air temperature setpoint.]
i. [Gas Heating Coil: Modulate gas valve to maintain discharge air temperature setpoint.]
j. [HW Coil Circulation Pump: Enable coil circulation pump whenever outside air temperatures are below 65 deg F (adjustable)].
k. DX Cooling Coil: Unit controls stage DX compressors, and [hot gas bypass][variable speed compressor] to maintain discharge air temperature setpoint.
l. Provide discharge air temperature reset based on space temperature to maintain space temperature setpoint.

4. Modes of Operation:
    a. The occupancy mode (occupied-unoccupied) shall be determined through a user-adjustable, graphical, seven-day schedule with an additional holiday schedule.
    b. Occupied Mode:
        1. The supply fan shall run continuously.
        2. [Relief/Exhaust fan shall run whenever the supply fan runs.]
        3. [Remote mounted relief/exhaust fan shall run whenever the supply fan runs]
        4. [Relief air dampers shall be enabled whenever the supply fan runs]

5. Outside air dampers shall be set to minimum position and enable mixed air and economizer functions.
6. Unit operates as outlined above.

c. Unoccupied Mode:
1. The supply fan shall be de-energized unless there is a call for heating or cooling in the space.
2. [Relief/Exhaust fan shall be de-energized.]
3. [Remote mounted relief/exhaust fan shall be de-energized]
4. [Relief air dampers shall be closed]
5. Both outdoor air dampers and exhaust dampers shall be closed. The return air damper shall be open.
6. Unit heating and cooling coils operate as outlined above to maintain discharge air temperature setpoint.

d. Morning Warm-up:
1. When the outside air temperature is below 55 degrees F, the DDC system shall perform a morning warm-up cycle prior to the occupied mode.
2. The supply fan shall operate.
3. [The relief/exhaust fan shall not operate]
4. [The remote mounted relief/exhaust fan shall not operate]
5. [The relief air dampers shall be closed]
6. The outside air damper shall be closed, and the return air damper shall be open.
7. Unit heating coil shall operate as outlined above to maintain discharge air temperature setpoint.
8. Cooling shall be disabled.
9. The Air Handling Unit shall remain in the morning warm-up mode until space it at the occupied space temperature setpoint.

e. Morning Cool-down:
1. When the system is in cooling night setback, the DDC system shall perform a morning cool-down cycle prior to the occupied mode.
2. If outside air temperature is below average space temperature:
   i. The supply fan shall operate.
   ii. [The relief/exhaust fan shall operate]
   iii. [The remote mounted relief/exhaust fan shall operate]
   iv. [The relief air dampers shall be open]
   v. The outside air dampers shall open and return air damper shall close.
   vi. The cooling and heating systems shall be disabled.
3. If the outside air temperature is above average space temperature:
   i. The supply fan shall operate.
   ii. [The relief/exhaust fan shall not operate]
   iii. [The remote mounted relief/exhaust fan shall not operate]
   iv. [The relief air dampers shall be closed]
   v. The outside air dampers shall close, and the return air damper shall open.
   vi. The cooling system shall be enabled and operate as outlined above to maintain discharge air temperature setpoint.
   vii. Heating system shall be disabled.
4. The Air Handling Unit shall remain in the morning cool-down mode until space is at occupied space temperature setpoint.

5. Safety Interlocks and Overrides:
a. Smoke Detectors: On the detection of smoke from a duct mounted smoke detector, a hard-wired interlock with the supply fan shall shut down the supply fan and [return fan][relief/exhaust fan][remote relief/exhaust fan(s)] through a signal to the VFD. The unit outside air and [unit relief][remote mounted relief] air dampers shall close. The smoke

detector shall furnished and wired by electrical and installed by mechanical. The duct mounted smoke detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider.

b. Freezestat: Freezestat located just downstream of the [HW coil][gas heating section] in the air handling unit shall cause the following, upon sensing a temperature less than 38 degrees F (adj.): The supply fan shall stop, [relief/exhaust fan][remote mounted relief fan] shall stop, all dampers shall close to outside air and the heating valve shall open to 100% or a programmed amount. An alarm shall be initiated to the BAS.
c. Supply Air Low Limit: Discharge air temperature sensor shall initiate an alarm, close outside air dampers, and modulate [the hot water][gas heating] control valve upon if the supply air temperature drops below 45 degrees F. when unit is in heating mode. Function disabled during cooling mode. This has priority over the needs of discharge air and CO2 control loops.
d. Duct Static Safety: A manual reset, high limit static pressure switch, located in the supply duct shall shut down the supply fan if it senses a static pressure above 2.5" (adj) WC. Initial high static pressure limit shall be set at 0.5” WC above scheduled external static pressure.

6. Monitor and Alarm Points: The value, binary state, setpoint, voltage, run hours, etc. of any input, output, control loop or virtual point shall be monitored on screen. Terminal mode group information screens shall be provided per the standards required by the District.
7. Operator Station Display:
   a. System occupied/unoccupied mode.
   b. Supply fan on/off indication.
   c. Supply fan current sensing relay alarm.
   d. [Relief/Exhaust fan on/off indication]
   e. [Relief/Exhaust fan current sensing relay alarm]
   f. [Relief/Exhaust fan VFD alarm]
   g. [Relief/Exhaust fan VFD speed indication]
   h. [Remote mounted Relief/Exhaust fan on/off indication]
   i. [Remote mounted Relief/Exhaust fan current sensing relay alarm]
   j. [Remote mounted Relief/Exhaust fan VFD alarm]
   k. [Remote mounted Relief/Exhaust fan VFD speed indication]
   l. [Remote mounted relief hood damper position]
   m. Outside air temperature indication
   n. Mixed air temperature indication
   o. Return air temperature indication
   p. Unit discharge air temperature indication.
   q. DX system Enable
   r. [Heating water control valve position]
   s. [Gas heating control valve position]
   t. Freeze stat alarm
   u. Smoke alarm
   v. Outside air setpoint
   w. Outside air indication
   x. Supply air discharge temperature control point adjustment
   y. Building static pressure indication
   z. Building static pressure control point adjustment
   aa. [HW coil circulation pump on/off indication]
   bb. [HW coil circulation pump current sensing relay alarm]
   cc. Unit CO2 level indication
   dd. Unit CO2 level control point adjustment.

I. MAKE-UP AIR SEQUENCE (MAU-1) [For general systems and systems serving kitchen space and not directly to kitchen hood]
   1. Description:
      a. The air handling unit shall consist of a package make-up air unit with supply air fan, [gas heating section][hot water heating coil][hot water heating coil with coil circulation pump], [and evaporative cooling section].
   2. General:
      a. Unit shall be provided with terminal strip for connection to BAS system by TC contractor.
      b. Unit shall be interlocked with kitchen hood switches and grease exhaust fans to operate whenever kitchen hoods operate.
      c. The Control Contractor shall connect each controller to the communication network, bind all applicable points, and program each unit controller in accordance with the following sequences
   3. System Control – Occupied Periods:
      a. Supply Fan Control: Fan shall run continuously during occupied periods.
      b. OA Control: OA damper opens whenever supply fan runs and kitchen hood is on. [RA damper closes whenever OA damper opens.]
      c. [Gas Heating: Modulate gas valve to maintain discharge air temperature setpoint. When kitchen hoods are operating minimum discharge air setpoint shall be 70 deg. F]
      d. [Hot Water Heating: Modulate temperature control valve to maintain discharge air setpoint. When kitchen hoods are operating minimum discharge air setpoint shall be 70 deg. F]
         1. [Hot water coil circulation pump operates whenever main heating system pumps operate.]
      e. [Evaporative Cooling: Enable evaporative cooling whenever there is a call for cooling. When outside air temperatures are below 50 deg. F enable evaporative cooler drain. When outside air temperatures are above 65 deg. F enable evaporative cooler fill.]
      f. Interlock unit to run whenever any kitchen hood exhaust fan runs.
   4. System Control – Un-Occupied Periods:
      a. Supply Fan Control: Cycle fan to maintain space temperature during un-occupied periods.
      b. OA Control: OA damper remains closed whenever in un-occupied period. RA damper opens whenever in un-occupied period or whenever hood fan is off.
      c. [Gas Heating: Modulate gas valve to maintain discharge air temperature setpoint. When kitchen hoods are operating minimum discharge air setpoint shall be 70 deg. F]
      d. [Hot Water Heating: Modulate temperature control valve to maintain discharge air setpoint. When kitchen hoods are operating minimum discharge air setpoint shall be 70 deg. F]
         1. [Hot water coil circulation pump operates whenever main heating system pumps operate.]
      e. [Evaporative Cooling: Enable evaporative cooling whenever there is a call for cooling. When outside air temperatures are below 50 deg. F enable evaporative cooler drain. When outside air temperatures are above 65 deg. F enable evaporative cooler fill.]
   5. Safety Interlocks and Overrides
      a. Smoke Detector: On the detection of smoke from a duct mounted smoke detector, a hard-wired interlock with the supply fan shall shut down the supply fan through a signal to the unit. The unit outside air dampers shall close. The smoke detector shall furnished and wired by electrical and installed by mechanical. The duct mounted smoke detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider.
      b. Upon activation of the kitchen hood fire system the unit supply air fan shall de-energize and the outside air damper shall close.

6. Monitor and Alarm Points: The value, binary state, setpoint, voltage, run hours, etc. of any input, output, control loop or virtual point shall be monitored on screen. Terminal mode group information screens shall be provided per the standards required by the District.
7. Operator Station Display:
    a. System on/off indication.
    b. System fan on/off indication.
    c. System fan current sensing relay alarm
    d. Fan discharge air temperature indication.
    e. Fan discharge air temperature setpoint/adjustment.
    f. Evaporative cooling system Enable
    g. Evaporative cooling system drain
    h. Evaporative cooling system fill
    i. Space temperature indication
    j. Space temperature setpoint/adjustment

J. KITCHEN MAKE-UP AIR SEQUENCE (MAU-1) [For systems directly to kitchen hood]
1. Description:
    a. The air handling unit shall consist of a package make-up air unit with supply air fan, [gas heating section][hot water heating coil][hot water heating coil with coil circulation pump], [and evaporative cooling section].
2. General:
    a. Unit shall be provided with terminal strip for connection to BAS system by TC contractor.
    b. Unit shall be interlocked with kitchen hood switches and grease exhaust fans to operate whenever kitchen hoods operate.
    c. The Control Contractor shall connect each controller to the communication network, bind all applicable points, and program each unit controller in accordance with the following sequences
3. System Control – Occupied Periods:
    a. Supply Fan Control: Fan shall run continuously whenever kitchen hood exhaust fan operates. Fan is off whenever kitchen hood fan is off.
    b. OA Control: OA damper opens whenever supply fan runs and kitchen hood is on. [Gas Heating: Modulate gas valve to maintain discharge air temperature setpoint. When kitchen hoods are operating minimum discharge air setpoint shall be 70 deg. F]
    c. [Hot Water Heating: Modulate temperature control valve to maintain discharge air setpoint. When kitchen hoods are operating minimum discharge air setpoint shall be 70 deg. F]
        1. [Hot water coil circulation pump operates whenever main heating system pumps operate.]
    d. [Evaporative Cooling: Enable evaporative cooling whenever there is a call for cooling. When outside air temperatures are below 50 deg. F enable evaporative cooler drain. When outside air temperatures are above 65 deg. F enable evaporative cooler fill.]
    e. Interlock unit to run whenever any kitchen hood exhaust fan runs.
4. Safety Interlocks and Overrides
    a. Smoke Detector: On the detection of smoke from a duct mounted smoke detector, a hard-wired interlock with the supply fan shall shut down the supply fan through a signal to the unit. The unit outside air dampers shall close. The smoke detector shall furnished and wired by electrical and installed by mechanical. The duct mounted smoke detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider.
    b. Upon activation of the kitchen hood fire system the unit supply air fan shall de-energize and the outside air damper shall close.

5. Monitor and Alarm Points: The value, binary state, setpoint, voltage, run hours, etc. of any input, output, control loop or virtual point shall be monitored on screen. Terminal mode group information screens shall be provided per the standards required by the District.
6. Operator Station Display:
    a. System on/off indication.
    b. System fan on/off indication.
    c. System fan current sensing relay alarm
    d. Fan discharge air temperature indication.
    e. Fan discharge air temperature setpoint/adjustment.
    f. Evaporative cooling system Enable
    g. Evaporative cooling system drain
    h. Evaporative cooling system fill

K. VAV TERMINAL UNIT SEQUENCES OF OPERATION
1. Temperature Setpoints:
    a. Occupied Space Temperature: 75 deg F. cooling, 70 Deg F. heating
    b. Un-Occupied Space Temperature: 85 deg F. cooling, 65 Deg F. heating
    c. Heating Discharge Air Temperature: 90 deg F.
2. VAV Box Operation:
    a. Cooling: Sequence damper from full open to minimum position. HW coil valve is closed.
    b. [Heating: Sequence damper from minimum to maximum heating and concurrently modulate HW coil control valve to maintain space temperature.]
    c. [Heating: Sequence damper from minimum to maximum heating and modulate electric heat states to maintain space temperature.]
3. FPVAV Box Operation:
    a. Fan: Fan is off during occupied periods. Fan is enabled during unoccupied periods.
    b. Occupied Cooling: Sequence damper from full open to minimum position. HW coil valve is closed.
    c. [Occupied Heating: Sequence damper from minimum to maximum heating and concurrently modulate HW coil control valve to maintain discharge air temperature.
    d. [Occupied Heating: Sequence damper from minimum to maximum heating and modulate electric heat states to maintain discharge air temperature.]
    e. [Unoccupied: Cycle fan and modulate HW coil valve to maintain space temperature.]
    f. [Unoccupied: Cycle fan and modulate stages of electric heat to maintain space temperature.]
4. Room CO2 Level Control
    a. During occupied mode, if the CO2 level rises above the space setpoint of [700][xxx] ppm (adj), the air valve (damper) shall slowly increment open as necessary to regain and maintain an allowable CO2 level. If the air valve (damper) when fully open, cannot maintain the proper CO2 level, the air handling unit is notified and shall slowly open its mixing damper to allow additional outside air.
5. Display
    a. System graphic
        1. Occupied/Unoccupied
        2. Space temperature setpoint
        3. Space temperature indication/adjustment
        4. [Control valve position]
        5. [Electric Heat Enable]
        6. Box leaving air temperature
        7. [Space CO2 Level]
        8. [Space CO2 Setpoint]
        9. [Space High CO2 Alarm]

10. [Fan Enable/Disable]
11. [Fan Alarm (from CSR)]

L. CABINET HEATERS
1. Cabinet Unit Heater, Hydronic: Room thermostat cycles fan.
2. Wall mounted thermostat cycles fan and opens control valve when space temperature falls below set point. Pipe mounted Aquastat stops fan when return heating-water space temperature falls below set point.

M. EXHAUST FAN SEQUENCES
1. Refer to mechanical equipment schedules, and drawings for specific fan control methods. Coordinate switched or thermostatically controlled fans with Division 26.
2. Switched Fans: Control by local On-Off switch provided by Division 26. Not a TC function. Provide a 2-position wall switch labeled with 1/2" lettering "Room Exhaust."
3. Line Voltage Thermostat Controlled Fans: Control by local 120-volt thermostat provided by TC. Not a TC function. Provide labeled thermostat with 1/2-inch lettering indicating exhaust fan served.
4. Low Voltage Thermostat Controlled Fans: Control by local low voltage thermostat provided and wired by TC. Provide labeled thermostat with 1/2-inch lettering indicating exhaust fan served.
5. DDC Interlocked Fans: Fans shall be enabled when the associated air handling unit is in occupied mode.
   a. Display and Alarms
      1. System graphic
      2. Fan status/alarm

N. KILN HOOD/KILN INTERLOCK SEQUENCES
1. Interlock kiln exhaust fan to operate whenever any kiln under the hood operates.
2. Provide space temperature sensor to operate exhaust fan whenever space temperature exceeds 85 deg F (adjustable).

O. MISCELLANEOUS POINTS
1. Computer Server Room (IDF Room)
   a. Monitor space Temperature and provide Status of exhaust fan.
2. Crawlspace Sump Pump(s)
   a. DDC system shall monitor sump pump operation/status. Alarm DDC system if pump fails, or upon high water level.
3. DDC Interlocked Dampers:
   a. Dampers shall be opened when the associated air handling unit is in occupied mode.
   b. Display and Alarms
      1. System graphic
      2. Damper position open/closed

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING AND WATER TREATMENT

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUES
   1. Heating Water Piping
   2. Chilled Water Piping
   3. Condenser Water Piping
   4. Air Elimination System
   5. Chemical Water Treatment

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Standard
      a. ANSI
      b. ASTM
      c. ASME
   2. Minimum Criteria
      a. Quality Assurance: The Water Treatment Company shall be a recognized specialist, active in the field of industrial water treatment, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and service department, plus a full-time service representative with a minimum of ten years' experience within in a Denver area. Acceptable Water Treatment Suppliers meeting the above requirements for this project is Mile Hi Water Tech, Inc.
      b. Chemical Water Treatment Maintenance Service:
         1. Provide the services of a fully qualified field engineer and laboratory and technical assistance from a fully qualified laboratory staff for a one (1) year warranty period.
         2. Chemical Stock: Provide sufficient chemicals for treatment and testing during the one (1) year warranty period. Chemicals shall not be harmful to the system in which they are used and shall comply with the Jurisdictional Codes governing the use and discharge of chemical formulations.

C. DESIGN REQUIREMENTS:
   1. Design piping systems with drain valves at main shut-off valves, low points of piping, bases of vertical risers and at equipment.
   2. Design piping systems with isolation valves to isolate each component and branch. Specify and Indicate location of isolation valves for each zone, each riser, all branches, and equipment including coils, air vents and all other hydronic equipment. Valves shall be readily accessible for servicing by maintenance personnel.
   3. Specify diaphragm-type expansion tanks to be used in the system, specify a diaphragm that is compatible with glycol. Plain steel expansion tanks are unacceptable.
   4. Specify flow measuring and balancing device combinations of orifices, venturis, throttling valves and temperature and pressure taps to provide accurate flow measurement for manual balancing of hydronic systems.
   5. For glycol-filled systems, specify that all components exposed to propylene glycol shall be compatible with the specified glycol (especially the seals and gaskets).

D. SUBMITTALS
   1. Product Data:
      a. Air Elimination System
      b. Pipe, Couplings and Fittings
      c. Chemical Water Treatment

2. Operating and Maintenance Data:
    a. Air Elimination System
    b. Chemical Water Treatment

E. RESTRICTIONS/CRITICAL CRITERIA
1. Chemical Water Treatment
    a. Pre-startup Cleaning and Flushing:
        1. The water treatment company shall provide a pre-startup liquid detergent dispersant cleaner for the flushing and cleaning of all closed water systems to remove oil and foreign matter form the piping and equipment prior to the final filling to the systems. This chemical shall not be injurious to person, piping, pipe joint compounds, packaging, coils, valves, pumps, and their mechanical seals, tubes, or other parts of the system.
        2. The water treatment company shall furnish complete instructions dictating the quantities of cleaner to use, methods and duration of operations.
    b. Chemical Feed Equipment for Closed Systems: Five (5) gallon bypass feeders shall be provided with ¾" brass drain valve. All feeders shall be able to withstand a maximum working pressure of 175 PSI.
    c. Condenser Water Systems (Cooling Towers):
        1. Acceptable Manufactures:
            i. Water Treatment Control Systems: Beta Technology, Inc. Omniview Conductivity Controller.
            ii. Water Meter- Carlon
            iii. Chemical Feed Pumps –Neptune N Feeder or LMI-A Series.
        2. Provide an automatic condenser water control system for inhibitor feed and blowdown. Inhibitor application shall be meter activated and blowdown shall be conductivity activated.
        3. Control system shall incorporate solid state integrated circuits and digital LED displays, in a painted steel enclosure. Provide gasketed and lockable door. A prewired, preplumed water sample assembly must be included.
        4. Total dissolved solids control for conductivity to include:
            i. LED digital conductivity readout display (microhm/cm).
            ii. Temperature compensated sensor probe and adaptable to sample stream manifold.
            iii. Two conductivity rangers: 0-2000 mmhos & 0-20000 mmhos.
            iv. Read-set switch for solenoid bleed valve.
            v. Illuminated light shall be indicated "Bleed" when valve is operated.
            vi. Adjustable hysteresis or dead band (internal).
            vii. Flow switch to deactivate feed and bleed when there is no flow.
        5. Inhibitor feed control based on make-up volume to include:
            i. Precision reset time (adjustable 1 to 255 minutes)
            ii. Test switch
            iii. Illuminated light shall indicated "feed" when pump is activated.
        6. Provide a Carlon 5/9" x 3/4" water meter with totalizer on system make-up, wired to control system.
        7. Provide one chemical feed pump to inject chemicals direct from the shipping drum into the condenser water supply to the tower.
        8. Provide a blowdown control assembly of sufficient size including a cast iron pipe strainer with 20 mesh stainless steel screen and solenoid valve.
        9. Provide a PVC piping manifold system to include a flow switch conductivity probe and sample petcock. The manifold system will be attached to the side of the controller, prewired and preplumbed.

d. Open System Water Treatment Chemicals:
    1. Provide an organic phosphorate based scale inhibitor containing molybdate based corrosion inhibitors and silt polymer-based dispersants. The treatment shall be in liquid form and be suitable for feeding into the system directly from the shipping container. This chemical treatment shall not contain chromate or phosphate. Acid for PH control not allowed.
    2. Provide liquid biocides of two chemically different types of formulation to be used on an alternating basis and to be effective against all normally encountered algae and slime growths. Biocides must be EPA approved.
    3. Provide chemical pump for algaecides.
    4. Provide full secondary containment pallet for all chemicals.
    5. Provide a fully functioning eyewash / shower station in close proximity to chemical storage, feed pumps and controller similar to Grainger product 34A699.
e. Water Treatment Control Testing Equipment:
    1. Provide testing chemicals to properly analyze the condenser water for organic phosphonate and closed system water for nitrite. Furnish the necessary test kits for these tests.
    2. Provide a Myron-L TDS meter, 3-range, 0-50, 0-500, 0-5000 mmhos/cm auto-temp compensation 50-160° F, 9-volt transistor batteries and built in cell.
    3. Furnish a supply of log sheets to record the test results and a bound copy of full test instructions.

2. Freeze Protection:
    a. Chilled and Heating Water Systems (for systems exposed to outdoors): Provide 30% Propylene Glycol with inhibitors.
    b. Provide a fully functioning eyewash / shower station in close proximity to chemical storage, feed pumps and controller similar to Grainger product 34A699.
3. Pipe Sizing:
    a. Chilled water, condenser water and heating water piping: Size pipe not to exceed a velocity of 6 feet per second and a maximum water pressure drop of 4 feet per 100 feet. Flow rates shall be based upon total connected load without diversity.

PART 2 – PRODUCTS

A. HEATING WATER, CONDENSER WATER AND CHILLED WATER PIPING
    1. Accessible Above Grade:
        a. 2” and smaller:
            1. Pipe: ASTM A53, Grade B, Schedule 40, Black Steel.
            2. Joints: Screwed.
            3. Fittings: ANSI/ASTM A126, 125 lb. cast iron or ANSI/ASTM A197, 150 lb. malleable iron.
            4. Unions: 250 lb. black malleable iron, ground joint with brass seat. Use dielectric unions to connect copper to steel piping.
            5. Copper tubing ASTM B88, Type L, hand drawn with ANSI/ASME B16.23 cast brass and/or ANSI/ASME B16.23 cast brass and/or ANSI/ASME B16.29 solder wrought copper may be used in lieu of steel pipe for size 1 ½” and smaller. Solder shall be no-lead type.
        b. 2 ½“ and larger:
            1. Pipe: ASTM A53, Grade B, Schedule 40, Black Steel.
            2. Joints: Welded.
            3. Fittings: ANSI/ASTM A234, Grade WPB, Schedule 40, seamless steel, butt weld type.
            4. Flanges: ASTM A181, Grade B, regular square head machine bolts with heavy hexagonal nuts to be used at equipment or valve connections only.

    2. Inaccessible Above Grade: Same as for 2 ½” and larger, accessible above grade.

3. Below Grade: Same as for 2 ½” and larger, except welded fittings. Provide bituminous pipe coating, minimum thickness 1 mil for all underground pipe.

B. AIR ELIMINATION SYSTEM
   1. Acceptable Manufactures:
      a. Bell and Gossett
      b. Amtrol
      c. Taco
      d. Wessels
   2. Expansion Tank: Pre-charged steel expansion tank with replaceable heavy duty butyl rubber bladder. The tank shall have a 1 ½" NPT system connection, 3/4" NPT drain and a .032"-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure.
   3. Air Separator: Cast iron or welded steel constructed, tested and stamped in accordance with Section VIII of the ASME Code for working pressure of 125 PSI. Provide integral strainer with air separator.
   4. Air Eliminator: Valve constructed of metal and non-corrosive working parts. Working pressure shall be 150 PSI. Coin operated or screw top air vents are not acceptable.
      a. Air: Eliminated to the atmosphere as fast as it is separated from system water through a float activated, remote pressure operated air elimination valve installed at the tip of the air separator.
      b. Air Elimination Valve: High removal rate at low pressure differentials and fully open for the removal of air at pressures in the operating range from 2 PSI to 150 PSI. Capacity shall not be less than 17 SCFM at 30 PSI.
      c. Valve: Tightly sealed against loss of system water and prevent entrance of air in negative pressure situations.

END OF SECTION

SECTION 23 21 23

HVAC PUMPS

PART 1- GENERAL

A. SUMMARY- SECTON INCLUDES
   1. Pumps

B. REFERENCED STANDARDS- MINIMUM CRITERIA
   1. HI- Hydraulic Institute, Standard for Centrifugal Pumps
   2. ASRM- American Society for Testing and Materials
   3. NEC- National Electric Code

C. SUBMITTALS
   1. Product Data: Pumps (HVAC)
   2. Operating and Maintenance Data: Pumps (HVAC)

D. RESTRICTIONS/CRITICAL CRITERIA
   1. General:
      a. Statically and dynamically balanced rotating parts.
      b. Construction: Permit complete servicing without breaking piping or motor connections.
      c. Pumps operate at 1750 RPM unless specified otherwise.
      d. Pump connection: Flanged.
      e. Pump manufacturer to check suction condition on pumps and provide pumps suitable for operation at proper net positive suction head (NPSH).
      f. Motor to be non-overloading at job site altitude (not exceed nameplate amperage) throughout the range of the pump curve. Motor shall be high efficiency. Refer Section 23 000 04 for additional requirements.
      g. Each pump shall be factory tested for the specified operating conditions. It shall then be thoroughly cleaned and painted with at least one (1) coat of high-grade machinery enamel prior to shipment.
      h. Pump shall be selected at or near maximum efficiency and shall not utilize impeller size more than 85% of the cut-water radius or smallest impeller available. Pump curves for all base mounted and horizontal close coupled circulating pumps shall not droop near shut- off.
      i. Impellers shall be bronze.
      j. Minimum of 70% efficiency at the design point for pumps larger than 3 HP.
      k. Install pumps to allow complete removal without dismantling connecting piping.
      l. Provide air cock and drain connection on horizontal pump casting.
      m. Provide flexible pipe connections for all base mounted pumps.
   2. Select pump motor as non-overloading over the entire pump curve shown by the manufacturer. Select pump based on operating temperatures and fluid types.
   3. Coil circulation pumps and system circulation pumps shall not be located above ceilings. Locate pumps where accessible in equipment rooms or within air handling equipment if located on roof.

PART 2- PRODUCTS

A. PUMPS
   1. Acceptable Manufacturers
      a. Pumps 3/4 HP and greater:
         1. Bell and Gossett

2. Paco
3. TACO

b. Pumps less than 3/4 HP:
1. Paco
2. TACO
3. Bell and Gossett

B. BASE-MOUNTED PUMPS
1. General Pump Requirements
a. Pump Units: Factory assembled and tested.
b. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be non-overloading over full range of pump performance curve. If variable speed drives are used, provide inverter duty motors.
c. Motors Indicated to Be Energy Efficient: minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B, if efficiency is not indicated.
2. Flexible-Coupled, End-Suction Pumps
a. Description: base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
1. Casing: cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tapping's at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Wear Rings: replaceable, bronze casing ring.
4. Shaft and Sleeve: steel shaft with bronze sleeve.
5. Seals: mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
6. Seals: stuffing box, with at least four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
7. Coupling: flexible, capable of absorbing torsional vibration and shaft misalignment.
8. Coupling Guard: steel, removable, and attached to mounting frame.
9. Mounting Frame: welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
10. Motor: secured to mounting frame, with adjustable alignment.

C. IN-LINE PUMPS
1. Description: Horizontal, in-line, centrifugal, single-stage, bronze-fitted, radially split case design; rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.
2. In-line pumps used for coil circulation shall include drain pan below pump. Drain pan shall include full size of pump and be drained to exterior or nearest floor drain/floor sink.

D. PUMP SPECIALTY FITTINGS
1. Suction Diffuser: angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers;

bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

2. Triple-Duty Valve: angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

END OF SECTION

SECTION 23 23 00

HVAC REFRIGERANT PIPING

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
    1. Refrigerant Piping and Fittings

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
    1. ASTM
    2. ANSI

C. SUBMITTALS
    1. Provide letter of guarantee of performance of A/C system to Owner.

D. RESTRICTIONS/CRITICAL CRITERIA
    1. Testing: All piping lines shall be pressurized with a 90% nitrogen, 10% refrigerant mixture to the design working pressure of the piping (i.e. discharge and liquid 400 PSI, suction 150 PSI). The test charge, with pressure gauges attached, shall be left for a period of twenty-four (24) hours. At the end of this period, regardless of whether a pressure drop is noted or not, a thorough leak search shall be performed on all piping joints including heat transfer coils.
    2. Specify environmentally friendly refrigerants. Specify R-410A or R-134A as preferred, R-123 is acceptable although not recommended.
    3. Specify refrigerant piping accessories as required for specific refrigeration equipment including:
        a. Filter dryer for liquid line of adequate size, replaceable if available.
        b. Sight glass moisture indicator installed in the liquid line at a convenient and accessible location.
        c. Liquid solenoid valve located near the expansion valve on systems using coil pump-down.
        d. Service hand valves shall be required on small and extensive or large refrigerant systems. They shall be located for component isolation purposes during normal maintenance.
        e. Liquid charging port and service valve installed in the liquid line on large systems.
        f. Oil separators required if evaporator is below 0°F and located below condensing unit.
        g. Oil traps to be installed if the vertical rise of refrigerant piping exceeds 8 feet.

PART 2- PRODUCTS

A. GENERAL
    1. Piping: Conforms with ASTM B-280 and ANSI B31.5.
        a. Type L, ACR hard drawn lengths.
        b. Soft annealed bendable lengths or coils.
    2. Fittings: As manufactured by Mueller Brass Streamline Series
        a. Wrought copper, refrigerant grade.
        b. Fittings shall be long radius.
        c. SAE forged brass flare fittings.

END OF SECTION

SECTION 23 30 00

FIRE AND SMOKE DAMPERS

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Fire and Smoke Dampers

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Regulatory Requirements: Comply with the following standards:
      a. NFPA 90A
      b. NFPA 90B
      c. UL Standard UL 555 and UL 555S
      d. SMACNA Fire Damper and Heat Stop Guide for Air Handling Systems.

C. SUBMITTALS
   1. Shop Drawings and Product Data: Fire Dampers, Smoke Dampers and Combination Fire/Smoke Dampers.

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Installation shall be in accordance with UL listing, SMACNA's Fire Damper Guide and damper manufacturer recommendations.
   2. Dampers shall be accessible for inspection or resetting through removable diffuser or register or access doors provided for the purpose. Location of access doors, when above ceilings, shall be marked FD or SD, F/SD, as appropriate.
   3. Provide dampers in duct work at ceiling, wall and floor penetrations as required by building codes.

PART 2- PRODUCTS

A. FIRE DAMPERS
   1. Acceptable Manufacturers:

      a. National Controlled Air
      b. Greenheck
      c. Air Balance
      d. Prefco
      e. Vent Products
      f. Nailor
      g. United Air
   2. Specify that fire dampers shall be constructed, tested, and labeled in accordance with UL555S Standard and shall also be in compliance with NFPA 90A.
   3. Specify that fire dampers shall be installed in accordance with their UL listing, NFPA 90A, and the manufacturer's installation instructions.

B. SMOKE AND COMBINATION FIRE/SMOKE DAMPERS
   1. Acceptable Manufactures:
      a. National Controlled Air
      b. Greenheck
      c. Nailor
      d. United Air

e. Prefco
f. Air Balance

2. Combination fire/smoke dampers shall be constructed, tested, and labeled in accordance with UL555/UL555S Standards and shall also be in compliance with NFPA 90A.
3. Combination fire/smoke dampers shall be installed in accordance with their UL listing, NFPA 90A, and the manufacturer's installation instructions.
4. Smoke dampers shall be constructed, tested, and labeled in accordance with UL555S Standard and shall also be in compliance with NFPA 90A.
5. Smoke dampers shall be installed in accordance with their UL listing, NFPA 90A, and the manufacturer's installation instructions.
6. Provide with electric (120V, 1Ø) operators in the buildings.

.END OF SECTION

SECTION 23 31 13

LOW PRESSURE SHEET METAL DUCTWORK

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Ductwork, Sealer and Accessories
   2. Ductwork Testing

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Regulatory Requirements: Comply with the following standards:
      a. NFPA 90A-2002: Air Conditioning and Ventilating Systems
      b. NFPA 90B-2002: Warm Air Heating and Air Conditioning Systems
      c. UL 181: Factory-Made Duct Materials and Air Duct Connections
      d. ASHRAE Handbook: Sheet Metal Design Standards
      e. SMACNA HVAC Duct Construction Standards, 2005 Edition with Supplements

C. SUBMITTALS
   1. Shop Drawings and Product Date:
      a. Low Pressure Ductwork, Flexible Connectors and Spin-In Fittings
      b. Low Pressure Flexible Ductwork
      c. Air Distribution Accessories

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Fiberglass ductwork not allowed except for return air sound boots and transfer air ducts.

PART 2- PRODUCTS

A. DUCTWORK
   1. General: Fabricate in accordance with referenced SMACNA HVAC Duct Construction Standards and ASHRAE Handbook. Use when subjected to total static pressures blew 2” WG. Duct gauges shall be as listed in Table 1-1 and Seal Class B, refer SMACNA manual. Rigid ductwork shall be constructed of “lock forming” quality galvanized steel. Exposed rectangular ductwork in Gymnasium to be 16 gauge.
   2. Hangers: Provide in accordance with referenced SMACNA Standards.
   3. Access Doors: Install hinged doors on ductwork and housing to provide access to parts of every automatic damper, fire damper, combination fire/smoke damper, duct coil, in-duct thermostat and other items requiring maintenance or inspection. Access doors shall be 24” x 24” minimum if permitted by duct size, and of not, shall be as large as possible. Access panels shall be at least two (2) gauges heavier than the surface in which place and shall be constructed as shown in Fig. 2-12 in SMACNA HVAC Duct Construction Standards.
   4. Provide airfoil turning vanes for all supply and return ductwork. Provide airfoil turning vanes for all outside air and relief air ductwork which include fan as means of providing outside air or relief air.

B. FLEX DUCT
   1. Approved Manufacturers:
      a. Flexmaster
      b. Hart & Cooley
      c. Thermoflex
      d. Wiremold
      e. Hercules

2. Insulated Flexmaster Type 5M: Branch duct connections to trunk duct shall be sheet metal spin-in type with integral damper and 45-degree extractor. Maximum length of flex duct shall not exceed 5 ft.

C. DUCTWORK- ALUMINUM
   1. All ductwork associated with the following systems shall be stainless steel, of B &S gauge conforming to appropriate ASHRAE Handbook (latest edition) with sealed joints. ANSI/ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength
      a. Dishwasher exhaust system.

D. DUCTWORK- WELDED STEEL
   1. All ductwork associated with the following systems to be 16 gauge welded black steel:
      a. Kitchen hood exhaust system
      b. Specify duct access doors for all grease exhaust duct per International Mechanical Code.

E. AIR DISTRIBUTION ACCESSORIES
   1. General:
      a. Provide all necessary air distribution system accessories to assure proper balance, quiet and draft less distribution and conveyance, minimization of turbulence, noise and pressure drop for all supply air qualities indicated.
      b. Products shall be recommended by the manufacturer for the application.
   2. Remote Operators: Provide Young Regulators Company remote damper operators where required for operation of dampers, splitter, extractors, etc.
   3. Control Grids: Provide control grids at entrance to all square or rectangular ceiling diffusers with square neck and side wall registers located at the end of branch run and distance from grid to diffuser or register face is 2'-0" or less. When distance exceeds 2'-0", and extractor shall be used.
   4. Volume Dampers: Construction: Volume damper frame shall be minimum 16-gauge galvanized steel. Blades shall be minimum 16-gauge galvanized steel, reinforced with 3 longitudinal structurally design vees. Linkage side assembly shall be concealed in frame located out of air stream. Bearing shall be synthetic sleeve type. Axles shall be ½" diameter plated steel with removable control shaft which extends 6" beyond frame.

F. GYMNASIUM/EXPOSED DUCTWORK
   1. Exposed Round Ductwork: Duct and fittings shall be equal to United Sheet Metal galvanized steel, meeting ASTM A-527-71. Duct shall be fabricated as spiral uniseal through 20" minor axis with longitudinal seam duct for minor axis of 22" or longer. All fittings shall be continuous weld. Exposed ductwork in Gymnasium to be 16 gauge.
      a. Exposed ductwork shall be paintlock type as required by architect for painting of ductwork in exposed areas.

G. OUTDOOR AIR LOUVERS AND HOODS
   1. For OA Intake Louvers: Provide plenum full size of intake louver, minimum 24" deep. Bottom of plenum shall be sealed liquid tight and slope to a 1" copper condensate drain. Extend condensate line to nearest floor drain.
   2. For OA Roof Mounted Intake Hoods: OA duct to be sealed liquid tight. At first horizontal offset provide 1" copper condensate drain. Bottom of horizontal offset provide 1" copper condensate drain. Bottom of horizontal duct shall be sealed liquid tight and sloped to condensate drain. Extend condensate line to nearest floor drain. Remainder of duct does not have to be sealed liquid tight.

END OF SECTION

SECTION 23 31 14

MEDIUM PRESSURE SHEET METAL DUCTWORK

PART 1- GENERAL

A. SUMMARY

1. Ductwork, Sealer and Accessories
2. Ductwork Testing

B. REFERENCED STANDARDS (MINIMUM CRITERIA)

1. Regulatory Requirements: Comply with the following standards:
   a. NFPA 90A: Air Conditioning and Ventilating Systems
   b. NFPA 90B: Warm Air Heating and Air Conditioning Systems
   c. UL 181: Factory-Made Duct Materials and Air Duct Connections
   d. ASHRAE Handbook: Sheet Metal Design Standards
   e. SMACNA HVAC Duct Construction Standards

C. SUBMITTALS

1. Shop Drawings and Product Data:
   a. Medium Pressure Ductwork: Spiral pipe, fittings, perforated metal liner, joint sealer and tape.
   b. Medium Pressure Flexible Ductwork

D. RESTRICTIONS/CRITICAL CRITERIA

1. General: The execution of the work shall be in strict accordance with the best practices of the trade and with these Specifications. All sheet metal ductwork shall be constructed in accordance with the current edition of the HVAC Duct Construction Standards published by the Sheet Metal and Air Conditioning Contractor National Association, Inc. (SMACNA).
2. Rectangular Ductwork: Duct gauges for rectangular ductwork shall be as listed in table 1-7 for 4” WG. Static positive seal class (A) of the SMACNA HVAC Duct Construction Standards. Duct to be constructed to higher static if system design requires more than 4” WG. Engineer shall consult with School District if system design requires static pressure greater than 4” WC.
3. Round and Oval Ductwork: The assembly and installation of pre-manufactured round and oval ductwork shall be in accordance with duct manufacturer’s recommendations. Provide adhesive on inside and outside of joints and tape and brush tape with sealer.
4. Medium pressure ductwork shall be tested in accordance with SMACNA recommendations.

PART 2- PRODUCTS

A. DUCTWORK

1. General: Fabricate all rectangular ductwork in accordance with referenced SMACNA HVAC Duct Construction Standard. All round ductwork and fittings shall be manufactured by a company who has as its principal business the manufacture of spiral pipe and welding fittings. The same firm shall manufacture the Ductwork and fittings to assure tight fit of all ductwork and components.
2. Oval and round ductwork: Duct and fittings shall be galvanized steel, meeting ASTM A-527-71. Duct shall be fabricated as spiral uniseal through 20” minor axis with longitudinal seam duct for minor axis of 22” or larger. All fittings shall be continuous weld. All take-offs shall be conical unless otherwise indicated. All ductwork which has conical take-offs and fittings shall be fabricated in accordance with ASTM A527-71. All take-offs shall be full body taps, saddles type taps not allowed.

a. Acceptable Manufactures:
    1. Hercules Industries
    2. LaPine Metal Products
    3. Spiral Pipe of Texas
3. Joint Sealing
    a. The sealing and duct slip joint and fitting connections of duct fittings shall be accomplished with UL listed sealer, sheet metal screws and sealing tape. Tape and sealer shall be compatible materials and designed for sealing medium/high pressure duct systems. Sealers shall be United Duct Sealer and Hardcast, Inc. RTA-50 adhesive.
    b. Flanged joints shall be sealed by Neoprene rubber gaskets.
    c. Round spin-in fitting connecting to rectangular duct shall be spun-in, locked in place with sheet metal screws and sealed.
4. Flexible connection at equipment shall be accordance with the requirements of MFPA 90A. Material shall be glass fabric coated on the exterior (not air side) with a fire-retardant compound. Duradynes “Excelon” or equal, with UL label. It shall be suitable for pressure encountered.

B. HANGERS
1. Provide in accordance with referenced SMACNA Standards.

C. ACCESS DOORS
1. Install hinged doors on ductwork and housing to provide access to parts of every automatic damper, fire damper, combination fire/smoke damper and other items requiring maintenance or inspection. Access doors shall be 24” x 24” minimum if permitted by duct size, and if not, shall be as large as possible. Access panels shall be at least two (2) gauges heavier than the surface in which placed and shall have sponge rubber gasket cemented in place.

D. FLEX DUCT
1. Approved Manufacturers:
    a. Flexmaster
    b. Wiremold
    c. Hart & Cooley
    d. Thermoflex
    e. Hercules
2. Insulated Flexmaster Type 3M insulated Type SLR-181: Branch duct connections to trunk duct shall be sheet metal spin-in conical type, equal to Flexmaster Series 3000S Model CB. Flex duct shall only be used to connect medium pressure SA duct to fan powered VAV terminal units. Maximum length of flex shall not exceed 6 ft.

END OF SECTION

SECTION 23 34 16

EXHAUST FANS

PART 1- GENERAL

A. SUMMARY- SECTION INCLUDES
   1. Exhaust Fans

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. AMCA

C. SUBMITTALS
   1. Product Data:
      a. Exhaust Fans
   2. Operating and Maintenance Data:
      a. Exhaust Fans

D. DESIGN REQUIREMENTS
   1. Specify direct drive fans for all fans 1/2hp and smaller. Specify belt drive fans for fans over 3/4hp.
   2. Centrifugal, tubular centrifugal, axial and propeller fans may be used. The use of propeller fans shall be kept to a minimum. The District shall approve the use of propeller type exhaust fans. Propeller fans shall include sound requirements for approval by the Engineer.
   3. All fan motors shall comply with 23 00 04 Motors and Drives
   4. Utility Set Fans:
      a. When only design solution requires exposure to weather, specify weather covers with quick release fasteners for ease of access to belts and bearings.
      b. Greaseable bearings for all accessible fans. Zerks shall be located outside of fan housing and extended where otherwise difficult to access.
   5. Specify vibration isolation devices for all utility set and hung cabinet fans. Vibration isolation shall minimize transmitted vibration to building structure. Refer to section 23 05 48.

PART 2- PRODUCTS

A. EXHAUST FANS
   1. Acceptable Manufacturers:
      a. Greenheck
      b. Acme
      c. Penn
      d. Loren Cook
      e. Carnes
      f. Twin City Fans
   2. Type, Capacity and Size: As indicated on drawings.
   3. General: Provide fans with statically and dynamically balanced wheels, free from objectionable vibrations. Capacities to be AMCA certified. Provide fans with permanently lubricated ball bearing motors located in separate compartment out of the airstream, factory roof curbs where required and back draft dampers.

B. ROOF FANS
   1. Housing: All aluminum venture inlet, bird screen.
   2. Wheel: (Type as indicated by model number).
      a. Centrifugal: Aluminum backward-inclined, balanced.
   3. Drive: (Type as indicated by model number).

a. Direct: Wheel keyed to shaft. Provide solid state speed controller or ECM motor to fan to allow for balancing of direct drive motors.
b. Belt: Adjustable sheaves, ball-type shaft bearings greased for operation to -10°F. Automatic belt tensioner or idler pulley systems are not approved for belt driven fans.

4. Motors: Ball bearings greased for operation to -10°F, out of primary air steam, built-in overload where scheduled, electrical disconnect.
5. Roof Club:
   a. Standard curb: Factory-built, 16" high (minimum), internally insulated, self-flashing roof curb. Curb height shall be sufficient enough to allow for fan cap to be a minimum of 12" above top of roofing.
   b. Sound attenuating curb: Factory-built, 16" high, internally insulated, self-flashing roof curb, heavy gauge galvanized steel with continuous welded water-tight corners. Rated at 40% fan sone reduction without appreciable air pressure drop. Sound baffles shall be vertical type, horizontal center baffle type not acceptable. Curb height shall be sufficient enough to allow for fan cap to be a minimum of 12" above top of roofing.
6. Accessories: Gravity back-draft damper (unless scheduled otherwise), miscellaneous items as scheduled.

C. CEILING AND IN-LINE CABINET FANS
1. Sound-insulated housing with back-draft damper, resiliently mounted direct-drive motor, centrifugal wheel, electrical disconnect, access to removable internals, inlet grille (ceiling fans), accessories as scheduled. Provide solid state speed controller or ECM motor to fan to allow for balancing of direct drive motors.

D. PROPELLER FAN
1. Housing: Steel panel with steel tubing supports pre-drilled fan panel with all parts except for wheel are furnished in baked enamel prior to assembly.
2. Blades: Variable pitch, five-bladed cast aluminum wheel, balanced.
3. Drive: Adjustable belt drive with belt guards.
4. Motors: Open drip-proof, ball bearings greased for operation to minus 10oF, built-in overload where scheduled.
5. Accessories: Heavy duty safety box guard to meet OSHA safety requirements and gravity operated damper.

E. UTILITY SET FANS
1. Description: belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
2. Housing: fabricated of steel with side sheets fully welded to scroll sheets.
   a. Housing Discharge Arrangement: adjustable to eight standard positions.
3. Fan Shaft: turned, ground, and polished steel; keyed to wheel hub.
4. Shaft Bearings: prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 200,000 hours.
5. Belt Drives: factory mounted, with final alignment and belt adjustment made after installation.
   a. Service Factor Based on Fan Motor: 1.5
   b. Motor Pulleys: adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   c. Belts: oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   d. Belt Guards: fabricate of steel for motors mounted on outside of fan cabinet.
   e. Utility set fans located on roof shall include mounting platform complete with vibration isolation between fan and platform.

END OF SECTION

SECTION 23 36 00

VARIABLE AIR VOLUME TERMINAL UNITS

PART 1- GENERAL

A. SUMMARY-SECTION INCLUDES
   1. VAV Terminal Units

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ARI
   2. NFPA

C. SUBMITTALS
   1. Shop Drawings and Product Data
      a. VAV Terminal Units- Cooling with reheat.
      b. VAV Terminal Units- Fan Powered
   2. Operating and Maintenance Data:
      a. VAV Terminal Units- Cooling with reheat.
      b. VAV Terminal Units- Fan Powered

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Installation
      a. Coordinate location with all ducts, beams, lights, piping, air distribution devices and other items in immediate vicinity of indicated locations. Make minor adjustments in exact locations shown to best fit available space.
      b. Make all duct connections to and from boxes in as streamlined a manner as practical so that air pressure drop is minimized. Make such connections air tight at operating pressures encountered.
      c. Locate terminals so that access for repair, maintenance and adjustment is easily facilitated without removal of other permanently located items which are in the immediate vicinity of terminals (this excludes removable ceiling panels, removable air distribution devices attached to flexible ductwork and other similar items).
   2. Fan Powered Terminal Units
      a. Due to maintenance concerns the use of fan powered terminals is restricted. Fan powered terminal units are allowed in Kindergarten Classrooms only. In the event the Engineer desires to use units in other locations he shall consult with the School District.
   3. VAV Terminal Unit Sizing
      a. The maximum total air pressure drop through the VAV Terminal Unit (includes air valve, housing, HW coil) shall not exceed 0.50” WG at nominal air valve CFM scheduled. Provide APD data in submittals.

PART 2- PRODUCTS

A. VAV TERMINAL UNITS
   1. Acceptable Manufacturers:
      a. Envirotec
      b. Carnes
      c. Metal Aire
      d. Titus
      e. Price Industries
   2. Model and Capacities: As indicated on drawings.
   3. Cooling with Reheat:

a. Performance: ARI shall certify all performance.
b. Options: Hot water coils shall come factory mounted on the discharge of the terminal unit casing with the capacity as shown on the schedule. Coil shall be constructed of aluminum fins with spacer collars to maintain uniform spacing. Fins shall be mechanically affixed to copper tubes insuring maximum heat transfer. All coils shall be tested to 400 PSIG. Right- or left-hand connections shall be as indicated on equipment drawings.

4. Fan Powered Series Type:
   a. Construction:
      1. Unit fan assembly shall be dynamically balanced, epoxy coated, forwardly curved, direct drive wheel.
      2. Blower motor shall be high efficiency, permanently lubricated sleeve bearing, . Name-plate full load amps must vary by tap. A three-tap motor switch shall be unit mounted and wired to preclude field wiring. Motor shall be suitable for 120V, 277V, or 208V single phase power. Single speed, single tap motors are not acceptable. In addition, an electronic speed controller or ECM motor shall be provided to fine balance the fan to specified CFM. Fan controller shall include a voltage limiting circuit to protect motor from stalling and eventual damage due to low RPM operation.
   b. Performance: All performance shall be tested in accordance with ARI 880.
   c. Options:
      1. Hot water coils shall be factory mounted on the discharge of the terminal unit casing with the capacity as shown on the schedule. Coil shall be constructed of aluminum fins with die-formed spacer collars to maintain uniform spacing. Copper tubes mechanically expanded into the fins. All coils shall be tested to 400 PSIG. Right- or left-hand connections shall be as indicated on equipment drawings.
      2. Attenuator: Fan powered terminal units shall be furnished with plenum inlet sound attenuator constructed of 22-gauge galvanized steel, lined with 1 inch glass fiber insulation. Insulation shall be UL listed and meet NFPA 90A and UL 181 requirements.
5. Temperature Control Contractor to provide DDC terminal controllers and damper actuators to terminal unit manufacturer with complete mounting and wiring instructions and demonstrations for factory mounting and wiring including power transformer. Terminal unit manufacture to include cost of mounting controls. Refer Section 23 09 00 for Temperature Control Contractor.

END OF SECTION

SECTION 23 37 13

AIR DISTRIBUTION

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Diffusers, Grilles, and Registers
   2. Louvers
   3. Intake and Relief Hoods

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Regulatory Requirements: Comply with the following standards:
      a. NFPA 90A-2002: Air Conditioning and Ventilating Systems
      b. NFPA 90B-2002: Warm Air Heating and Air Conditioning System

C. SUBMITTALS
   1. Shop Drawings and Product Data:
      a. Diffusers, Grilles, and Registers
      b. Louvers
      c. Intake and Relief Hoods

D. RESITRICTIONS/CRITICAL CRITERIA
   1. Provide safety chains for all FRD's located in Gymnasiums.
   2. Intake and relief hoods shall have extended necks and internal 1" thick insulation on underside of hood. Roof curb to be minimum 14" high.
   3. Seal ductwork and provide condensate drain lines for intake louvers and intake hoods. Refer Section 23 31 13.

E. INTAKE AND RELIEF
   1. Design outside air intakes protected from prevailing winds.
   2. Size intake louvers to prevent the infiltration of snow and rain. Do not exceed manufacturer's recommended inlet velocities.
   3. Locate intake hoods a minimum of 30 feet from plumbing vents and exhaust outlets. Locate relief vents a minimum of 20 feet from operable windows.

PART 2 – PRODUCTS

A. DIFFUSERS, GRILLES, AND REGISTERS
   1. Acceptable Manufacturers:
      a. Titus
      b. Metal Aire
      c. Price Industries
      d. Manufacturer, Sizes and Finishes: As indicated on drawings.
   2. Ceiling Diffusers:
      a. Rectangular/square louvered face type.
   3. Ceiling Registers and Grilles:
      a. Ceiling supply registers and grilles shall be adjustable curved blades, double deflection type.
   4. Ceiling Return and Exhaust Grilles/Registers:
      a. Square or rectangular curved blades or eggcrate type.
      b. Exhaust and return registers shall include integral volume damper.

5. Sidewall Supply Registers:
    a. Heavy duty type with integral volume damper and 2-way throw.
    b. Registers shall include tamper-proof hardware.
6. Sidewall Return/Exhaust Registers:
    a. Heavy duty type with integral volume damper and 2-way throw.
    b. Registers shall include tamper-proof hardware.

B. LOUVERS
1. Acceptable Manufacturers
    a. Greenheck
    b. Loren Cook
    c. Acme
2. Furnished and installed by Mechanical Contractor.
3. Louvers shall be drainable and have aluminum bird screen.

C. INTAKE AND RELIEF HOODS
1. Acceptable Manufacturers:
    a. Greenheck
    b. Loren Cook
    c. Acme
2. Intake and Relief hoods shall include backdraft dampers. Motorized dampers for relief air hoods and include building pressurization control. Intake dampers are recommended to be two position motorized type.
3. Intake and relief hoods shall be mounted on 24” minimum curb, with hinged hood cap for access to dampers.
4. Intake and Relief hoods over 48” square shall include 12”x12” minimum weatherproof access door for inspection of backdraft damper. Hoods over 60” square shall include 24”x24” weatherproof access door for inspection and maintenance on backdraft damper without removal of hood.

END OF SECTION

SECTION 23 52 23

NON-CONDENSING BOILERS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Boilers with Burner Units

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Comply with the applicable sections of the ASME Boiler Code.
   2. Install boilers in accordance with the manufacturer's installation instructions and requirements of International Fuel Gas Code and CSD-1 requirements. Complete work in a neat and workmanlike manner.

C. SUBMITTALS
   1. Shop Drawings and Product Data:
      a. Boilers and Burners
   2. Operation and Maintenance Data:
      a. Boilers and Burners

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Install boilers and surrounding piping and appurtenances so components requiring service are easily accessible and removable.
   2. Provide System Startup, refer Section 23 05 97.
   3. Provide Demonstrations, refer Section 23 05 97.
   4. The use of non-condensing boiler systems shall be limited to the replacement of existing boiler plants where condensing boiler plants are not feasible. Coordinate with the District for current operating limits and requirements for the existing boiler plant to determine if condensing boilers are feasible, or if non-condensing boiler plants are required.
   5. Non-condensing boiler plants shall include fire-tube, water-tube, and cast-iron boilers.
   6. Specify supply and return water temperatures which will not cause damage to boilers. Specify boiler circulation pumps. Refer to 23 09 00 for boiler control requirements.
   7. The design engineer shall be responsible for field verifying all existing conditions associated with the boiler replacement. Field verification shall include, but not be limited to, combustion air system, make-up air systems, control system and distribution system. Verify all components are operating properly for the new design. Engineers shall specify the repairs required to make the systems operational.
   8. Engineer shall verify the existing heating system in the boiler room. If the room is being heated by the boiler heat loss, the engineer shall design a new supplemental heating system. The system shall be capable of heating the room to a minimum of 50°F at all times. The engineer shall be responsible for specifying the requirements for freeze protection of all of the lines within the boiler room. Specify motorized dampers for combustion air ducts for freeze protection. Specify interlock with dampers to operate/open whenever any boiler or water heater operates.
   9. Provide an emergency shutoff switch (EPO) at entry into boiler room if not already present.

PART 2 – PRODUCTS

A. BOILERS
   1. Acceptable Boiler Manufacturers:
      a. Weil-McLain
      b. Buderus
      c. HB Smith

2. Acceptable Burner Manufacturers:
    a. Power Flame
    b. Riello
    c. Beckett
3. Boiler shall be constructed in accordance with the provisions of Section IV of the ASME Boiler and Pressure Vessel Code and shall be stamped with the required official ASME symbol. The water boiler maximum working pressure will be 50 PSIG.
4. The entire fuel burner system and its installation shall conform with the manufacturer's erecting instructions, with applicable codes.
5. The gas burner shall be UL listed and certified and shall be of a design which produces flame retention with rapid intimate mixing of the fuel and combustion air. The burner shall be designed to ensure high efficiency and good performance under either balanced draft or forced draft venting conditions. The burner shall be capable of being adjusted to provide 9 1/2% to 10% CO2 for natural gas firing.
6. Controls shall be as required by International Mechanical Code, International Fuel Gas Code, and CSD-1, including operating control, high limit control, two (2) low water controls per each boiler, flame failure control, etc. The boiler and control shall comply with the requirements of FM. Provide two (2) motorized gas shut-off valves for each boiler.
7. One LWCO shall be McDonnell Miller No. 63M.
8. Honeywell Guardring Model RW700A1031.
9. Accessories shall include pressure-temperature-altitude gauge, 50 PSI ASME relief valve.
10. Due to building layout, it may be necessary for boiler to operate at a working pressure of 75 PSI. In the event this is necessary, provide an 80 PSI ASME relief valve and replace the McDonnell Miller No. 63M LWCO with model capable of operating at 80 PSI.
11. Ensure boiler room and installation allows for proper service clearances as recommended by boiler and burner manufacturer. Clearances shall include space for removal of burner, opening of burner door(s), and space for boiler/section removal. Include sufficient space for maintenance of boiler components and internals.

END OF SECTION

SECTION 23 52 24

CONDENSING BOILERS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Boilers with Burner Units

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Comply with the applicable section of the ASME Boiler Code.
   2. Install boilers in accordance with the manufacturer's installation instructions and requirements of International Fuel Gas Code and CSD-1 requirements. Complete work in a neat and workmanlike manner.
   3. ANSI Z21.13/CSA 4.9 (Gas Fired Low Pressure Boilers)
   4. NFPA 54 (ANSI Z221.3) National Fuel Gas Code
   5. Factory Mutual
   6. ASME CSD-1 (Controls and Safety Devices)

C. SUBMITTALS
   1. Shop Drawings and Product Data:
      a. Boilers with Burners
   2. Operating and Maintenance Data:
      a. Boilers with Burners

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Install boilers and surrounding piping and appurtenances so components requiring service are easily accessible and removable.
   2. Provide System Startup, refer Section 23 05 97.
   3. Provide Demonstrations, refer Section 23 05 97.
   4. Review boiler manufacturer's instructions for the installation of multiple boiler systems. Boiler systems utilizing three or more boilers shall include boiler isolation valves.
   5. Review boiler manufactures instructions and recommendations for combustion air and flue requirements. Specify common combustion air where space in existing building does not allow for individual connections. Specify individual boiler flues where possible. Where space is not available common vents may be specified. Refer to boiler manufactures recommendations for flue sizing, All common flue systems shall be engineered systems.
   6. Specify individual gas connections utilizing individual regulators whenever possible. Headered systems utilizing a single gas pressure regulator are not recommended.
   7. For multiple boiler systems, specify manufacturer's boiler control panel to allow for multiple boiler operations. Control panel shall allow for any boiler to be taken offline for service, without losing control from the DDC system. DDC system shall provide control for supply water temperature setpoint, and boiler alarm indications. General boiler alarms are not acceptable. Daisy chained control from a primary boiler is not recommended unless when primary boiler is taken out for service, remaining boilers re-assign primary boiler control.
   8. Condensing boiler shall include stainless steel pressure vessel and tubes. Cast aluminum, cast iron, copper finned, or similar materials are not approved for condensing boiler applications.

E. CERTIFICATIONS
   1. Manufacturer's Certification: The boiler manufacture shall certify the following:
      a. The products and systems furnished are in strict compliance with the specifications.

b. The boiler, burner and associated mechanical and electrical equipment have been properly coordinated and integrated to provide a complete and operable boiler.
c. ASME certification.
d. CSA (AGA/CGA certification.
e. Specified factory tests have been satisfactorily performed.
f. The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

2. Contractor's Certification: the contractor shall certify the following:
a. The products and systems installed are in compliance with the Contract Documents and all applicable local and state codes.
b. Specified field tests have been satisfactorily performed.
c. The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

F. DELIVERY, STORAGE AND HANDLING
1. The Contractor shall be responsible for the timely delivery of equipment at the jobsite. The Contractor shall be responsible for unloading and rigging equipment from weather, humidity and temperature conditions, dirt, dust, and other contaminants, as well as jobsite conditions during construction.
2. Equipment shall be unloaded, handled, and stored in accordance with manufacturer's handling and storage instructions.

PART 2 – PRODUCTS

A. BOILERS
1. Acceptable Manufacturers:
a. Aerco (Benchmark)
b. Fulton (Endura, Endura +, Endura XE)
c. Lochinvar (Crest)

2. Boiler shall be constructed in accordance with the provisions of Section IV of the ASME Boiler and Pressure Vessel Code and shall be stamped with the required official ASME symbol. The water boiler maximum working pressure will be 80 PSIG.
3. The entire fuel burner system and its installation shall conform with the manufacture's erecting instructions, with applicable codes.
4. Burner shall incorporate all necessary devices and controls to make a complete fuel burning system for natural gas and bear the listing label of UL evidencing compliance with the requirements of UL-795 and meet CSD-1 and FM codes for gas burners. The burner shall be full modulating whereby the firing rate is infinitely proportional at any firing rate between 20% to 100% as determined by control input signal. The burner shall be designed to insure high efficiency and good performance under either balanced draft or forded draft venting conditions. The burner shall be capable of being adjusted to provide no less than 9 1.2% CO_2, 4.5% O_2, 200 ppm CO at full firing with natural gas. Burner shall be Power Flame or Webster and sized to provide the output at altitude.
5. Controls shall be as required by International Mechanical Code, International Fuel Gas Code, and CSD-1, including operating control, high limit control, and motorized gas shut-off valves for each boiler.
a. LWCO to be factory installed.
b. Provide factory integrated and provided flame guard.
6. Accessories shall include pressure-temperature-altitude gauge, 50 PSI ASME relief valve.

7. Provide acid neutralization interceptor for boiler condensate.
8. Boiler to be certified for installation with Category IV venting (stack) as defined in NFPA 54 (ANSI Z221). Flue material shall be AL294C.

END OF SECTION

SECTION 23 64 00

AIR COOLED LIQUID CHILLER

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Chiller

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Chiller Factory Test: Unit shall be run under full load conditions at factory on laboratory type calorimeter to check overall unit performance including capacity (tons and KW), vibration, operation controls, and safety cutout performance.
   2. Conform to ANSI/ARI 590 Standard for testing and rating of Positive Displacement Compressor Water – Chilling Packages or conform to ANSI/ARI 550 Standard for testing and rating of Centrifugal and Rotary Screw Water – Chilling Packages.
   3. Conform to ANSI/UL 465 Code for construction of water chillers and provide UL label. In the even the unit is not UL approved, the manufacture shall, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
   4. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.
   5. Conform to ANSI/ASHRAE 15 code for construction and operation of water chillers.
   6. Warranty: Provide five (5) year manufacturer's warranty to include coverage for complete chiller package as manufactured and delivered to site including materials and labor.

C. SUBMITTALS
   1. Shop Drawings:
      a. Chiller
   2. Operating and Maintenance Data:
      a. Chiller

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Specify air cooled chillers with sound attenuation package for compressor section and condenser fans. Sound attenuation shall comply with section 23 00 02 and 23 05 48. Specify sound requirements on construction documents. Sound package shall be reviewed with District prior to issue of construction documents.
   2. Louvered panels over compressor section and all exposed components for rodent and bird protection. Condenser coil hail guards for condenser coils. Angled condenser coils require condenser coil hail guards, louvered panels for condenser section.
   3. Construction and Finish: Units shall be constructed of welded steel frame with a 12-gauge galvanized steel cabinet. Unit shall be finished with a baked-on power paint for panels and control boxes, the structural base shall be finished with air dry paint.
   3. Evaporator: The evaporator shall have independent refrigerant circuits with gasketed evaporator heads. Chiller shall include a minimum of two refrigerant circuits. The evaporator shall be shell-and-tube design with seamless copper tubes roller-expanded into tube sheets or multi-circuit brazed plate type with individually brazed stainless steel plates. Evaporator shall be designed, tested and stamped in accordance with ASME code for a refrigerant side working pressure of 300 PSIG. Waterside working pressure shall be 215 PSIG. Insulation shall be 3/4" flexible closed cell with a maximum K value of 0.26. A water drain connection, bulb wells for the temperature controller, and low temperature cutout, and flare connections.

on water inlet and outlet for pressure drop measurements shall provided. Heater tapes protect evaporator and all internal water piping down to an ambient of - 20°F.

4. Condenser:
    a. Air-cooled condenser coils shall be circuited and upright with configurator aluminum fins mechanically bonded and seamless copper tubing. Condenser shall include integral sub cooling circuit with liquid accumulators. All condensers shall be factory air under water leak-tested at 506 PSIG air pressure.
    b. Condenser fan shall be direct drive, vertical discharge, statically and dynamically balanced. Condenser fan motors shall be 3-phase with permanently lubricated ball bearing and 3-phase thermal overload protection.
    c. Standard low ambient units start and operate to 0°F ambient.
5. Compressor and Lube Oil System:
    a. Screw Type Compressors: Construct semi-hermetic helical rotary screw compressors with head treated forged steel or ductile iron shafts, discharge valves, and sealing surface immersed in oil. Rotors shall be of high-grade steel or cast-iron alloy.
    b. Scroll Type Compressors:
    c. Statically and dynamically balance rotating parts.
    d. Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping and normal operation.
    e. Provide compressor with automatic capacity reduction equipment consisting of capacity control slide valve. Compressor must start unloaded for soft start on motors.
    f. Provide constant speed (3600 RPM) compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection, designed for across-the-line or star delta starting. Furnish with start. Compressor motor power factor shall be .90, power factor correction capacitors must be installed.
6. Refrigeration Circuits: Each Unit has two refrigerant circuits. Each refrigerant circuit includes: A compressor suction and discharge service valve, liquid line shutoff valve, removable core filter drier, liquid line sight glass with moisture indicator, charging port and an electronic expansion valve. Fully modulating compressors and electronic expansion valves provide variable capacity modulation over the entire operating range.
    a. Capacity modulation:
        - Screw Chiller: Provide capacity modulation by either slide valve or unloader valves. Unit shall be capable of operation down to 10%. In the event a manufacture cannot provide unit with modulation down to 10%, Hot Gas Bypass must be provided with limitations in accordance with the International Energy Conservation Code.
        - Scroll Chiller: Provide variable speed scroll compressor(s) for capacity control. A minimum of one variable speed scroll compressor shall be specified for each chiller.
7. Control Panel:
    a. Each weather-tight control panel has started and refrigeration controls in separate sections. Starter section has internal access door, main single-point power connection terminal block and customer connection junction box provided with knockouts for remote interlocks. Starter section also contains power controls for part wind start (Star Wye Delta closed transition starter), thermal black for control power function, terminal strip, compressor starter relay, reset relay and non-recycling compressor overload relay.
    b. Provide the following safety controls with indicating lights or diagnostic readouts.
        - Low chilled water temperature protection.
        - High refrigerant pressure.
        - Low oil flow protection.
        - Loss of chilled water flow.
        - Contact for remote emergency shutdown.
        - Loss of refrigerant charge protection.

- Motor current overload

Phase reversal/unbalance/single phasing.
- Over/under voltage.
- Failure of water temperature sensor used by controller.
- Compressor status (on or off).

c. Provide the following operating controls:
- Eight (8) or more step leaving chilled water temperature controller which cycles compressors and activates cylinder unloaders or slide valve based on PI algorithms. If manufacturer is unable to provide at least 8 steps of unloading, providing hot gas bypass shall be required.
- Five-minute solid state anti-recycle timer to prevent compressor from short cycling.

d. Provide ammeters for each compressor or digital display of % RLA on microprocessor.

e. Provide remote mounted alarm and display panel with a minimum of the following features:
- Leaving chiller water temperature set point adjustment.
- Display diagnostics.
- Display entering and leaving water temperatures.
- Display active chilled water and current limit set point.
- Display ambient temperature.
- Display parts failures:
- Water temperature and ambient temperature sensors
- Motor contactors
- Unit Controller
- Condenser and evaporator refrigerant temperature sensors.

8. DDC Sequential Panel
   a. General: A microprocessor-based control panel shall provide chiller plant control for two chillers. The control panel shall be factory programmed and require only minimal configuration at the job site. The chiller sequencing software shall incorporate the following features and control strategies.
   b. Piping System Options: The sequencing panel shall support single pump per chiller, single system pump, or decoupled systems as required in the specification.
   c. System Enable: System start shall be initiated either by a time clock or generic BAS systems though the closure of a set of binary contacts or by the operator from the DDC Sequencing Panel key pad.
   d. Set point Control: The system chilled water set point shall be operator adjustable though the panel keypad and display.
   e. Chilled Water Reset: The sequencing panel software shall provide the option of either load based, or ambient based chilled water reset.
   f. Soft Loading: A soft loading function shall prevent start of the lag chiller during initial chilled water loop pulldown for twice the normal delay.
9. Coordination: Coordinate control functions and connections with Temperature Control Contractor.
10. Completion Services
    a. Start-Up Services: Start up system in accordance with Section 23 05 97. Manufacture shall furnish a factory trained representative without charge for five (5) working days.
    b. Demonstration: Manufacturer's representative shall instruct the Owner's personnel in accordance with Section 23 05 95.

PART 2 PRODUCTS

A. CHILLER
   1. Acceptable Manufactures:
      a. Trane
      b. S m a r d t

c. York/Johnson Controls (JCI)

2. Model and Size: As indicated on Drawings.
3. General: Air-Cooled water chiller shall be furnished complete with compressor(s), factory-mounted condenser, evaporator, thermal expansion valve(s) and control panel. Units to have a minimum of two completely independent refrigerant circuits. All units shall ship with a full operating charge of refrigerant and oil.

END OF SECTION

SECTION 23 64 16

WATER COOLED CENTRIFUGAL CHILLER

PART 1 – GENERAL

A. SUNNARY – SECTION INCLUDES
   1. Chiller

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. Chiller Test: Unit shall be run under full load conditions at factory to check overall unit performance, including capacity (tons and KW), operation controls and safety cutout performance. Provide test report at conditions scheduled and under ARI conditions.
      a. Vibration test report by factory submitted to Owner.
   2. ARI 550 – Centrifugal or Rotary Water-Chilling Packages.
   3. ASHRAE 15 – Safety Code for Mechanical Refrigeration.
   4. NEC – National Electrical Code.
   5. ASME SEC 8 – Boiler and Pressure Vessel Code.
   6. NEMA MG1 – Motors and Generators.
   7. ARI 575 – Method of Measuring Machinery sound within an Equipment Space.
   8. ANSI – Safety codes for Mechanical Refrigeration
   9. Warranty: Provide five (5) year manufacturer's warranty to include coverage for complete chiller package as manufactured and delivered to site including materials and labor.

C. SUBMITTALS
   1. Shop Drawings:
      a. Chiller
      b. Manufacturer's Certificate: Certify that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.
      c. Test Report: Indicated energy input versus cooling load output from 35% to 100% of full load at specified and minimum condenser water temperature of 68° F.
   2. Operating and Maintenance Data:
      a. Chiller: Include start-up instructions, maintenance data, parts list controls and accessories. Include trouble-shooting guide.

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Manufactured Units
      a. Provide factory assembled and tested, packaged, water cooled, liquid chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, refrigeration accessories, pressure relief devices, rupture disks, all instrumentation and controls, auxiliary components and accessories. Construction and ratings shall be in accordance with ARI 550.
      b. Units shall have Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90A.
      c. Conform to ARI 550 Code for testing and rating of centrifugal chillers.
      d. Conform to UL 465 code for construction of centrifugal chillers and provide UL label.
      e. Conform to ASME SEC 8 for construction and testing of centrifugal chillers.
      f. Conform to ASHRAE 15 code for construction and operation of centrifugal chillers.
      g. Chiller and accessories shall be selected for operation above 6000 feet elevation.
      h. Self-exited vibration velocity shall be less than 0.10 inch/second in any of the three axes.

i. Manufacturer of the chiller shall provide noise criteria (NC) sound level across all octave band center frequencies for scheduled cooling capacities.

2. Compressor
   a. Compressor Casing: Cast iron, horizontally or vertically split with machined passages, leak tested with refrigerant trace gas to 45 PSIG.
   b. Impeller: Single or multi-stage, in-line design, fully shrouded, statically, and dynamically balanced, tested to 20% over operation speed, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.
   c. Guide Vanes: Modulating radical blade dampers, on each stage, with externally mounted electric operator, suitable for capacity reduction to 10% of specified load without hot gas bypass when supplied with design entering water quantity and 80° F design temperature entering condenser water.
   d. Bearings: Babbitt lined sleeve bearings, self-aligning, pressure lubricated.
   e. Gear Box: Double helical design, symmetrical and center supported by spherically seated, self-aligning bearing, arranged for inspection without disassembly.
   f. Motor: Hermetically sealed, singled speed, low slop induction type. If an open motor design is used, then the manufacture shall state the heat dissipation to the room and maximum allowable ambient room temperature with submittals.
   g. Lubrication: Direct drive, positive displacement, hermetic motor driven oil pump, with oil cooler, pressure regulator, oil filters, thermostatically controlled oil heater and motor controls, Interlock to start before chiller motor and run after motor is shut down. Provide sight glass for monitoring oil level.
   h. Relief valve in compressor circuit.
3. Evaporator
   a. Provide evaporator of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral finds, rolled or silver brazed into tube sheets. Space tube support sheets approximately 2.5 feet. Minimum tube thickness 0.035 inches.
   b. Design, test and stamp refrigerant side for a tested pressure equal to 1.3 times the maximum operating pressure but not less than 100 PSIG working pressure and water side for 1.5 times the maximum operating pressure but not less than 150 PSIG working pressure, in accordance with ASME SEC 8.
   c. Provide standard type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without distributing refrigerant.
   d. Provide combination pressure relief valve – rupture disk on shell in accordance with ASHRAE 15. The resettable pressure relief valve shall be installed downstream of the rupture disk to function as a secondary pressure relieving device which is capable of resetting after safe chiller pressure has been established.
   e. Construction and materials shall conform to ASME SEC. 8.
   f. Inlet piping shall have pressure relief valve, furnished by installing contractor.
4. Condenser
   a. Provide condenser of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Space support sheets approximately 2.5 feet. Minimum tube thickness 0.035 inches.
   b. Design, test and stamp refrigerant side for a tested pressure equal to 1.3 times the maximum operating pressure but not less than 100 PSIG working pressure and water side for 1.5 times the maximum operating pressure but not less than 150 PSIG working pressure, in accordance with ASME SEC 8.

c. Provide standard type water boxes, machine welded to heat exchanger with tapped rain and vent connections, and flanged or mechanical joint connections arranged to permit inspections of tubes from either end without disturbing refrigerant.
d. Provide combination pressure relief valve – rupture disk on shell in accordance with ASHRAE 15. The resettable pressure relief valve shall be installed downstream of the carbon rupture disk to function as a secondary pressure relieving device which is capable of resetting after safe chiller pressure has been established.
e. Construction and material shall conform to ASME SEC 8.
f. Inlet piping shall have pressure relief valve, furnished by installing contractor.

5. Purge System: Provide purge system that can operate independently of the chiller and operate which the machine circulation water pump is shut down. Purge system to operate automatically for removing any non-condensable discharge and refrigerant return. Remove water with manual blow-off valve.
6. Refrigerant Monitor: Provide a refrigerant monitor that can be calibrated for appropriate refrigerant, capable of detecting concentrations of 10 PPM for low level leak detection when proposing Class B1 refrigerant.
7. Controls
   a. On or near chiller, mount steel control panel containing solid state fully automatic operating and safety controls.
   b. Provide the following safety controls arranged so that operating any one will shut down machine and require manual reset:
      1. Low evaporator refrigerant temperate.
      2. High condenser refrigerant pressure.
      3. Low Oil pressure
      4. High oil temperature.
      5. High motor current.
      6. Low refrigerant (evaporator) pressure.
      7. Dry contact for remote trouble indication.
      8. No starter transition.
      9. Low chilled water temperature.
      10. Low flow reading from the chilled water flow switch.
      11. Remote shut down from Building Automation System.
      12. Loss of condenser water flow.
   c. Provide the following devices on control panel:
      1. Manual Switches:
         i. Machine off-auto switch.
         ii. Oil pump switch (automatic).
      2. Manual set Point Adjustments:
         i. Leaving chilled water temperature (between 45° F and 55° F).
         ii. Current Demand Limit
      3. Status Lights/ Pressure Gauges:
         i. Unit running, including remote status via contact closure.
         ii. Unit loading, including remote load status output @ 4-20 mA DC.
         iii. Unit unloading.
         iv. Evaporator refrigerant pressure.
         v. Condenser refrigerant pressure.
         vi. Low oil pressure (oil sump).
         vii. High pressure (oil supply).
         viii. Chiller trouble alarm, via contact closure.
         ix. Start-up in progress.
         x. Anti-recycle timer active.
         xi. Condenser water pump on.

xii. Chilled water pump on.
xiii. Oil Pump on.
xiv. Chiller on.

4. Set point and Temperature Display:
   i. Chilled water set point.
   ii. Current limit set point.
   iii. Entering evaporator water temperature.
   iv. Leaving evaporator water temperature.
   v. Entering condenser water temperature.
   vi. Leaving condenser water temperature.

d. Provide the following operating controls:
   1. Solid state, chilled water temperature controller which controls hydraulically operated guide vane operator. Locate temperature sensor in entering and leaving chilled water.
   2. Adjustable thirty minute off time prevents compressor from short cycling.
   3. Demand limit device to manually set maximum current infinitely between 35% and 100% of full load amperes.
   4. Automation System shall enable chiller.

8. Starter
   a. Acceptable Manufactures
      1. Cutler Hammer
      2. Square D
      3. GE
   b. On chiller, mount steel NEMA 1 type enclosure, containing Star-Delta closed transition start, manufactured in accordance with chiller manufacturer's specifications and factory tested.
   c. Enclosure shall be designed for top or bottom cable entry with from access. Dorr, interlocked with circuit breaker, shall accommodate padlock.
   d. Mount the following devices within enclosure:
      1. Disconnect switch on line side with fuses.
      2. High interrupting capacity circuit breaker with ground fault protection.
      3. Pilot relays to start and stop compressor on signal from chiller control panel.
      4. Solid state microprocessor-based motor overload protection protects compressor motor from distribution system irregularities and provides motor current signal to chiller capacity control module.
      5. Control power transformer.
      6. Fused control circuits for control circuit, oil pump motor, oil heater and purge control unit.
      7. Capacitors, one per phase to correct power factor to minimum 90%.
      8. Relay for remote mounted emergency shut-down switch.
   e. Provide the following devices or alternatively solid-state microprocessor-based motor overload protection display panel on starter door.
      1. Starter fault trip indicator and reset.
      2. Overload trip indicator and reset.
      3. Ground fault trip indicator and reset.
      4. Ammeters, one per phase.
      5. Voltmeters, one per phase.
   f. Distribution fault protection to prevent re-connection of the compressor motor while it is out-of-phase with the line voltage. If a distribution fault is detected, the fault trip indicator shall be displayed, and a manual reset shall be required. Distribution faults of 1 ½" electrical cycle durations shall be detected on the compressor motor shall be disconnected within six electrical circles.

9. Coordination: Coordinate control functions and connections with Temperature Control Contractor.
10. Completion Services
    a. Start-Up Services: Start up system in accordance with Section 23 05 97.
        1. Provide services of factory trained representative for minimum 2 days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, instruct Owner on operation and maintenance.
        2. Supply initial charge of refrigerant and oil.
    b. Demonstration: Manufacturer's representative shall instruct the Owner's personnel accordance with Section 23 05 9. Verify specified performance.

PART 2 – PRODUCTS

A. CHILLERS
    1. Acceptable Manufacturers:
        a. Trane
        b. Smardt
        c. York/Johnson Controls (JCI)

END OF SECTION

SECTION 23 64 36

AIR COOLED CONDENSING UNITS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Air cooled refrigerant condensing units

B. REFERENCES STANDARDS (MINIMUM CRITERIA)
   1. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; (ANSI/ASHRAE Std 15).
   2. ASHRAE Std 20 - Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc...
   3. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; Latest Edition, Including All Addenda (ANSI/ASHRAE/IES Std 90.1)
   4. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc.; Current Edition, Including All Revisions
   5. Provide five (5) years warranty on compressors as manufactured and delivered to site including materials and labor.

C. SUBMITTALS
   1. Shop Drawings.
   2. Manufacturer's Certificate: Certify that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.
   3. Operating and maintenance Data:
      a. Air cooled condenser: Include start-up instructions, maintenance data, parts list, controls and accessories. Include trouble-shooting guide.

D. RESTRICTIONS/CRITICAL CRITERIA
   1. For units to be installed in sound sensitive areas specify with sound attenuation package for compressor section and condenser fans. Sound attenuation shall comply with section 23 00 02 and 23 05 48. Specify sound requirements on construction documents. Sound package shall be reviewed with District prior to issue of construction documents.
   2. General: Factory assembled, piped, internally wired, and fully charged. Designed to operate at outdoor ambient temperatures as high as 115 degrees F. Designed for outdoor rooftop or ground level installation.
      a. Units 7-1/2 tons and greater shall have a minimum of dual compressors with separate refrigeration circuits.
      b. Provide multiple compressor units with means of capacity modulation by variable speed compressor, inverter compressor, or similar capacity controls. Hot gas bypass may be utilized on limited applications although is not preferred. Hot gas bypass shall be limited in capacity as required in the International Energy Conservation Code.
   3. Cooling: Rated in accordance with ARI Standards
   4. Refrigerant Controls: Refrigerant controls include condenser fan, and compressor contactors, and 24V transformer. Safety controls include high- and low-pressure controls and compressor overloads.
   5. Compressors: Compressors shall be 3600 RPM hermetic sealed compressors and shall be equipped with over temperature, over current and high-pressure controls. Provide crankcase heaters. Compressors shall have five (5) year warranty.

6. Condenser Coil: Condenser coil shall be seamless copper tubing mechanically bonded to aluminum fins. Factory pressure and leak tested at 450 PSIG. Units are dual circuited.
7. Condenser Coils: aluminum fins mechanically bonded to seamless copper tubing.
    a. Condenser coil hail guard and rodent protection. Provide unit with louvered guard consisting of 1/2”x1/2” wire fabric secured to unit exterior with galvanized or aluminum strips. Guards shall be removable to allow for service and access to coil sections.
8. Condenser Fan: Condenser fan shall be direct drive, statically and dynamically balanced, up flow propeller type. Weatherproofed permanently split capacitor fan motor shall have built-in thermal overload, permanently lubricated sleeve bearings and be U.L. listed for outdoor use.
9. Controls: Refer to sections 23 09 00 and 23 09 90 for control components and sequences of operations.
10. Start-up Services: Start up system in accordance with Section 23 05 97. Manufacturer shall furnish a factory trained representative without charge for five (5) working days.
11. Demonstration: Manufacturer’s representative shall instruct the Owner’s personnel in accordance with Section 23 05 95.

PART 2 – PRODUCTS

A. ACCEPTABLE MANUFACTURES.
    1. Trane
    2. Carrier
    3. York/Johnson Controls (JCI)
    4. Approved Substitute

END OF SECTION

SECTION 23 65 12

INDUCED DRAFT COOLING TOWER

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Cooling Tower

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ANSI/AFBMA 9 – Load Rating and Fatigue Life for Ball Bearings.
   2. ANSI/AFBMA 11 – Load Rating and Fatigue Life for Roller Bearings.
   3. ASME PTC-23 – Atmospheric Water-Cooling Equipment.
   4. CTI ATC-105 – Acceptance Test Code for Water Cooling Towers.
   5. CTI – Certification Standard STD-201.
   6. NEMA 250 – Enclosure for Electrical Equipment (1000 Volts maximum).
   7. NEC – National Electrical Code.
   8. Warranty: Provide five (5) year warranty.
   9. Extra Materials: Provide one set of matched fan belts, three spray nozzles for each cell, one gasket for each access door, one valve seat for each make-up or control valve.

C. SUBMITTALS
   1. Shop Drawings:
      a. Cooling Tower Product Data : Indicate rated capacities, flow characteristics, nozzle performance, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, location, and size of field connections. Submit schematic indicating capacity controls.
      b. Manufacturer’s Certificate: Certify performance, based on CTI STD-201, and submit performance curve plotting leaving water temperature against wet bulb temperature.
      c. Manufacturer’s Installation Instructions: Provide pertinent information for proper installation.
   2. Operating and Maintenance Data:
      a. Cooling Tower: Include star-up instructions, maintenance data, spare and replacement, parts list, controls, and accessories.

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Manufactured Unit
      a. Provide unit for outdoor use, factory assembled, sectional, crossflow, vertical discharge, induced draft type, with sump, fan, surface sections, drift eliminators and motors.
   2. Components
      a. Framework and Casing: Support structure and basin constructed of hot-dip galvanized steel with a minimum coating of 2 ½ ounces per square foot conforming to ASTM A-123 and fiberglass reinforced polyester (FRP).
      b. Louvers: Fiberglass reinforced polyester (FRP) spaced to minimize air resistance and splash out.
      c. Fan: Multi blade, aluminum alloy blades, axial type with one-piece, multi-grooved neoprene/polyester belt drive, bearings with life expectancy of 40,000 hours, with extended grease fittings. Grease packed bearings shall have moisture proof seals and integral slinger rings. Shafts shall be stainless steel.
      d. Motor: Fan motors shall be totally enclosed air over (TEAO) type, high efficiency, reversible, squirrel cage, ball bearing type designed especially for cooling tower service. Motor shall be furnished with special moisture protection on windings, shafts, and bearings. Motor shall be located outside of air stream.

e. Extended lubrication lines shall be provided for easy maintenance utilizing a single point of application.
f. Gear Drive: designed for minimum 150% motor nameplate power.
g. Fan Guard: One-piece, welded steel rod and wire guard, hot dipped galvanized after fabrication over each fan cylinder.
h. Access: Large access doors for access to eliminators and fan plenum. Access doors shall be coordinated with access platform to assure proper alignment of doors and platform.
i. Distribution Basin: Open, gravity type distribution basin utilizing water diffusers and plastic metering orifices.
    1. Individual upper distribution piping fed from main headers equipped with flow control valves so that any cell may be shut down from maintenance without interfering with operation of any other cell.
    2. Low pressure, splash-type distribution nozzles.
    3. Single ASA 125 lb. serrated flat face flanged connection for the hot water inlet.
j. Wet Deck Surface and Drift Eliminators: Formed from polyvinyl chloride (PVC), and shall be impervious to rot, decay and fungus or biological attacks. Drift eliminator shall be 2 pass.
    1. Drift losses shall not exceed 0.2% of cooling tower capacity.
k. Collection Basin: One piece welded self-cleaning stainless steel with depressed center section, including interconnection of cell basins of size to match sump outlet with isolation valves, designed to support tower, with cleanout and drain fitting, ¼" stainless steel mesh strainer, bottom outlet sump with anti-vortex device and removable screen and overflow.
l. Float Valves: Brass or bronze make-up valve with plastic or copper float.
m. Hardware: Nuts, bolts, washers, and nails shall be stainless steel.
n. Finish: Steel components shall be G235 hot dipped galvanized steel with edges protected with zinc rich compound.

3. Accessories
    a. Vibration Cut-Out Switch: Provide vibration cut-out switch mounted on fan support framework to shut off fan when subjected to excessive vibration.
    b. Condenser Water Control System: Electric water control system shall interface with DDC system. The cooling tower manufacturer shall provide the following accessories:
        1. Electric water level control
        2. Low level cutout
        3. Low level alarm
        4. High level alarm
        5. Make-up on
        6. Make-up off
    c. Variable frequency drive or 2-speed fan motor.
    d. Extended lubrication lines.
    e. Sump debris screens.
    f. Mount unit on spring type vibration isolators.
4. Completion Services
    a. Start-Up Services: Start up system in accordance with Section 23 05 97. Manufacture shall furnish a factory trained representative without charge for one (1) working day.
    b. Demonstration: Manufacturer's representative shall instruct the Owner's personnel in accordance with Section 23 05 95.
5. Specify cooling towers with sound mitigation measures. Specify with variable speed and/or quiet fans. Specify specific sound levels for tower on construction documents. Sound levels shall be reviewed prior to issuing of construction documents. Refer to sections 23 00 02 and 23 05 48 for sound requirements.

6. Wherever possible specify towers with bottom outlet connections. Side outlet towers should be avoided whenever possible. Coordinate tower elevations and piping requirements with architectural for enclosures.

PART 2 – PRODUCTS

A. COOLING TOWER
   1. Acceptable Manufacturers:
      a. Baltimore Air Coil Co.
      b. Marley
      c. Evapco

END OF SECTION

SECTION 23 73 13

AIR HANDLING UNITS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Air Handling Units

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ARI
   2. ANSI

C. SUBMITTALS
   1. Product Data:
      a. Air Handling Units
   2. Operating and Maintenance Data:
      a. Air Handling Units

D. RESTRICTIONS/CRITICAL CRITERIA
   1. Manufacturer of air handling units shall provide noise criteria (NC) sound level across all octave band center frequencies for catalog operating range of unit a gross cooling capacity range. Data shall be obtained in conformance with ANSI S1.32 (American National Standard Methods for the Determination of Sound Power Levels at Discrete Frequency and Narrow Band Noise Sources in Reverberation Rooms) and per AMCA Standard 300-85 test code “Sound Rating Air Moving Devices”/ Provide sound power levels for discharge and return for the supply fan.
   2. Unit Casing: Unit shall be constructed of a complete frame with removable panels. The casing must be able to withstand up to six-inches positive or four-inches negative static pressure. Condensate pan shall be sloped in two planes to ensure complete condensate drainage. Condensate pan shall be double wall construction.
      a. Full sized hinged removable double-wall access doors with two-step safety handles shall be provided for quick access to the interior of the unit casing. Doors attached by screws or doors not continuously gasketed are not acceptable.
      b. Casing Options: Unit shall be double wall constructed to prevent insulation erosion into the airstream and to allow cleaning of the unit interior. Interior wall shall be a minimum of two-inches thick of either 20-guage solid or 18-guage perforated or solid plate galvanized steel. Foil faced insulation is not acceptable.
   3. Insulation: Unit shall be factory insulated with a minimum R-5 insulation system. Insulation shall be fiberglass or foam injected panels. All connecting channels shall be insulated to prevent sweating.
   4. Filter Modules: Filter sections shall have filter racks, an access door for filter removal and block-offs as required to prevent air bypass around filters. Modules shall be supplied with 2-inch angled filters.
   5. Fans
      a. Fans shall be double width, double inlet, multi-blade type as manufactured by the unit manufacturer. Fans shall be forward curve (FC), backward inclined (BI) or backward inclined airfoil (AF) as required for stable operation, refer schedule for fan type. Propeller type exhaust fans are not approved.
      b. Housed fan performance shall be certified as complying with ARI Standard 430-89. Centrifugal fans shall be dynamically balanced at the factory as a complete fan assembly (fan wheel, motor, drive, and belts). Fan shafts shall not exceed 75% of their first critical speed at any cataloged rpm.

c. Fans shall be equipped with self-aligning, anti-friction pillow block bearings with a minimum life of L-50 200,000 hours. Bearings shall be equipped with grease lines allowing for lubrication from one side of the fan.
d. Fan and motor assembly shall be internally isolated from unit casing with spring isolators, furnished and installed by unit manufacturer. Vibration isolators shall be nominal 2-inch static deflection. Fan scroll shall be attached to the unit casing by a flexible canvas duct.
e. Fan Options
    1. Unit sizes 35 and larger shall be provided with a totally enclosed galvanized expanded metal belt guard. The belt guard shall be rigidly attached to the bearing support structure and have a two-piece removable front panel. A tach hole shall be provided opposite the fan shaft. The belt guard shall be a universal size to accommodate any applicable drive.
    2. Grease lines for both bearings shall be extended to the fan support bracket on the drive side.
f. Fan Modulation: For variable volume application air flow shall be modulated by VFD or ECM

6. Motors.
    a. Motors shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motors shall be mounted inside the unit casing. Motors shall be mounted on a slide base to permit adjustment of drive belt tension.
    b. Motors shall be high efficiency with a power factor of 0.85 or higher. Refer Section 23 00 04 for additional requirements.
    c. Motor frame shall be ‘T’ frame.
7. Drives
    a. Drives shall be variable pitch, suitable for adjustment within 5% of specified rpm.
    b. Drives shall be selected at 1.2 service factor.
8. Coils
    a. Coils shall be manufactured by the same company as the supplier of the air handling unit. Coils shall be designed with aluminum plate fins and copper tubes.
    b. Fins shall have collars drawn, belled, and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops, and selection procedure shall be certified in accordance with ARI Standard 410.
    c. Water Coils
        1. All coils shall be enclosed in a coil section. Coil headers and U-bends shall not be exposed.
        2. Coils shall have a supply header to ensure distribution of hot water to each tube of coil.
        3. Coils shall be proof tested to 300 psig and leak tested to 200 psig, air pressure underwater.
        4. Maximum 12 fins per inch.
        5. Cooling coils to have fins with ZRC to prevent water carryover. Coils to be capable of operating at 640 FPM with a fin spacing of 10 fins per inch with no water carry over.
        6. Specify sufficient space between coils to allow for installation of controls components, and coil cleaning.
        7. Heating water coil additional criteria: Sufficient space shall be provided within unit to allow for coil, circulation pump piping and service requirements. Coil control valve and circulation pump may not be located above ceilings. For units which do not allow for sufficient space, provide coil piping vestibule. Vestibule shall be of similar construction to units, fully insulated, and include full size access doors. Provide secondary drain pan for heating water coil circulation pump. Extend drain to unit exterior.

d. DX Coils
    1. DX cooling coil, coil shall be seamless copper tubing mechanically bonded to aluminum fins. Factory pressure and leak tested at 450 PSIG.
    2. Coils above 10-tons shall be dual circuited (minimum)
    3. Refrigerant piping shall be in accordance with manufacturer's recommendations for design refrigerant piping lengths and configurations. Refer to section 23 23 00 for refrigerant piping requirements.
    4. Outdoor condensing unit shall be sized to accommodate DX coil requirements. Refer to section 23 64 26 for condensing unit requirements.
    5. Specify sufficient space between coils to allow for installation of controls components, and coil cleaning.

9. Damper Mixing Box, Mixing Box, Filter Mixing Box and Economizer Module: A module shall be provided that supports damper assembly for outside, return and/or exhaust air. Economizer module shall be capable of supporting 100% outside air economizer function. Specify gravity relief air dampers or motorized relief air dampers to enable building pressure control if return air fan is not included in unit construction. Coordinate requirements with building elements such as relief air hoods and relief air fans.
10. Dampers: Dampers shall modulate the volume of outside, return or exhaust air. Dampers shall be double-skin airfoil design with metal compressible jamb seals and extrude vinyl blade edge seals on all blades. The dampers shall be rated for a maximum leakage rate of less than 1 percent of nominal airflow at 1-inch wg. Blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in parallel or opposed blade configuration.
11. Installation: When unit is located in crawl space, allow minimum of 12" clearance between unit and bottom of structure.
12. Completion Services
    a. Start-Up Services: start-up system in accordance with Section 23 05 97.
    b. Demonstration: Instruct the Owner's personnel in accordance with Section 23 05 95.
13. Controls:
    a. Controls shall be as specified in accordance with Section 20 09 00. All unit controls shall be TC contractor. Unit control components shall be provided by TC contractor and factory installed.

PART 2 – PRODUCTS

A. AIR HANDLING UNITS
    1. Acceptable Manufacturers (Modular and Package):
        a. AAON
        b. Carrier
        c. Engineered Air
        d. Trane
    2. Acceptable Manufacturers (Custom):
        a. Engineered Air
        b. Mammoth/Temptrol/Governair
        c. Annex Air

END OF SECTION

SECTION 23 74 13

PACKAGE ROOFTOP UNITS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Rooftop HVAC Units

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ARI

C. SUBMITTALS
   1. Product Data:
      a. Rooftop HVAC Units
   2. Operation and Maintenance Data:
      a. Rooftop HVAC Units

D. RESTRICTIONS/CRITICAL CRITERIA
   1. For units to be installed in sound sensitive areas specify with sound attenuation package for compressor section and condenser fans. Sound attenuation shall comply with section 23 00 02 and 23 05 48. Specify sound requirements on construction documents. Sound package shall be reviewed with District prior to issue of construction documents.
   2. General
      a. Units:
         1. Factory assembled, piped, internally wired, and fully charged with R-410A.
         2. Designed to operate at outdoor ambient temperatures as high as 115 degrees F.
         3. Designed for outdoor rooftop or ground level installation.
         4. Units 7-1/2 tons and greater shall have a minimum of dual compressors with separate refrigeration circuits.
      b. Cooling: Rated in accordance with ARI Standards.
      c. Cooling Units: UL listed and labeled, classified in accordance to UL 1995.
      d. Exterior surfaces: Manufacturers standard finish of baked enamel or painted finish with primer undercoat.
      e. Panels: 20-gauge steel, gasketed and insulated.
   3. Refrigerant Controls: Refrigerant controls include condenser fan, evaporator fan and compressor contactors, and 24V transformer. Safety controls include high- and low-pressure controls and compressor overloads.
   4. Compressors: Compressors shall be 3600 RPM hermetic sealed compressors and shall be equipped with over temperature, over current and high-pressure controls. Provide crankcase heaters. Unit shall be capable of operating at published CFMs on cooling cycle. Compressors shall have five (5) year warranty.
   5. Evaporator Coil: Evaporator coil shall be seamless copper tubing mechanically bonded to aluminum fins. Factory pressure and leak tested at 200 PSIG. Units have two (2) independent circuits.
   6. Drain Pans: Stainless steel evaporator pans internally sealed and insulated. Provide threaded drain connection in evaporator section.
   7. Condenser Coil: Condenser coil shall be seamless copper tubing mechanically bonded to aluminum fins. Factory pressure and leak tested at 450 PSIG. Units are dual circuited.
   8. Indoor Air Fan: Indoor air fan shall belt driven, forward curved, centrifugal type, equipped with adjustable motor sheaves. Provide motor with thermal overload protection. Permanently lubricated fan and motor bearings. Fan drive components are mounted on rubber-in-shear isolators. Motor to be of the high efficiency type.

9. Condenser Fan: Condenser fan shall be direct drive, statically and dynamically balanced, up flow propeller type. Weatherproofed permanently split capacitor fan motor shall have built-in thermal overload, permanently lubricated sleeve bearings and be U.L. listed for outdoor use.
10. Heating Section:
    a. Water Heating Coils:
        1. Coils shall be manufactured by the same company as the supplier of the air handling unit.
        2. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops, and selection procedure shall be certified in accordance with ARI Standard 410
        3. All coils shall be enclosed in a coil section. Coil headers and U-bends shall not be exposed. Coils shall have a supply header to ensure distribution of hot water to each tube of coil.
        4. Sufficient space shall be provided within unit to allow for coil, circulation pump piping and service requirements. Coil control valve and circulation pump may not be located above ceilings. For units which do not allow for sufficient space, provide coil piping vestibule. Vestibule shall be of similar construction to units, fully insulated, and include full size access doors.
        5. Provide secondary drain pan for heating water coil circulation pump. Extend drain to unit exterior.
    b. Natural Gas Heating Section:
        1. Gas units AGA-approved specifically for outdoor installation.
        2. Heat exchanger: stainless steel or aluminized steel, forced draft blow assembly.
11. Filters: Two (2”) inch throw-away filters.
12. Fans:
    a. Fan and motor assembly shall be internally isolated from unit casing with neoprene or spring isolators, furnished and installed by unit manufacturer.
    b. Motors shall be high efficiency with a power factor of 0.85 or higher. Refer Section 23 00 04 for additional requirements.
    c. Fans shall be forward curve (FC), backward inclined (BI) or backward inclined airfoil (AF) as required for stable operation. Propeller type exhaust fans for unit exhaust/relief are not approved.
13. Accessories and Options: The following factory installed options or field installed accessories shall be provided:
    a. Roof Curb. Roof mounting curb shall be of sufficient height to maintain a minimum of 12” between bottom of rooftop unit and finished roof.
    b. Economizer: The assembly includes Fully modulating 0-100% motor and dampers, minimum position setting, preset linkage, wiring harness with plug and fixed dry bulb control (0-10 VDC or 4-20 MA).
    c. Low ambient compressor lockout control for ambient temperatures at 45°F or less.
    d. Anti-short cycle: A lockout timer provides a minimum off time of five (5) minutes between compressor cycling.
    e. Condenser coil hail guard and rodent protection. Provide unit with louvered guard consisting of 1/2”x1/2” wire fabric secured to unit exterior with galvanized or aluminum strips. Guards shall be removable to allow for service and access to coil sections.
    f. Specify a 115-volt convenience outlet on unit sized to manage a small power load or service light. Outlet shall be powered independently from unit power.
14. Installation
    a. Separate openings for supply and return duct shall be cut in roof. Annular space between roof opening and sheet metal ductwork shall be sealed. Provide Minimum of 4” acoustic insulation within roof curb. Insulation shall consist of rigid fiberglass insulation, rigid foam

insulation, or fiberglass batt insulation. Joints shall be staggered and taped. In lieu of fiberglass insulation 4” thick light weight concrete may be used.

15. Controls:
    a. Refer to sections 23 09 00 and 23 09 90 for control components and sequences of operations.
16. Completion of Services
    a. Demonstration: Manufacturer’s representative shall instruct the Owner’s personnel in accordance with Section 23 05 95.
    b. Start-up: Refer Section 23 05 97.

PART 2 – PRODUCTS

A. ACCEPTABLE MANUFACTURERS
    1. Rooftop HVAC Units:
        a. Trane
        b. Aaon
        c. York; Johnson Controls (JCI)
        d. Engineered Air

END OF SECTION

SECTION 23 74 33

MAKE-UP AIR UNITS

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Rooftop Make-up Air Units

B. REFERENCED STANDARDS (MINIMUM CRITERIA)
   1. ARI

C. SUBMITTALS
   1. Product Data:
      a. Make-up Air Units
   2. Operation and Maintenance Data:
      a. Make-up Air Units

D. RESTRICTIONS/CRITICAL CRITERIA
   1. For units to be installed in sound sensitive areas specify with sound attenuation package for compressor section and condenser fans. Sound attenuation shall comply with section 23 00 02 and 23 05 48. Specify sound requirements on construction documents. Sound package shall be reviewed with District prior to issue of construction documents.
   2. General
      a. Units:
         1. Factory assembled and internally wired.
         2. Designed to operate at outdoor ambient temperatures as high as 115 degrees F. for cooling, and as low as -10 degrees F for heating.
         3. Designed for outdoor rooftop or ground level installation utilizing natural gas heating section or heating water coil section.
         4. Provide evaporative cooling section where required by District for units serving as space cooling. DX cooling may be utilized at request from District.
      b. Exterior surfaces: Manufacturers standard finish of baked enamel or painted finish with primer undercoat.
      c. Panels: 20-gauge steel, gasketed and insulated.
   3. Drain Pans: Stainless steel evaporator pans internally sealed and insulated. Provide threaded drain connection in evaporator section.
   4. Indoor Air Fan: Indoor air fan shall belt driven, forward curved, centrifugal type, equipped with adjustable motor sheaves. Provide motor with thermal overload protection. Permanently lubricated fan and motor bearings. Fan drive components are mounted on rubber-in-shear isolators. Motor to be of the high efficiency type.
   5. Heating Section:
      a. Water Heating Coils:
         1. Coils shall be manufactured by the same company as the supplier of the air handling unit.
         2. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops, and selection procedure shall be certified in accordance with ARI Standard 410
         3. All coils shall be enclosed in a coil section. Coil headers and U-bends shall not be exposed. Coils shall have a supply header to ensure distribution of hot water to each tube of coil.
         4. Sufficient space shall be provided within unit to allow for coil, circulation pump piping and service requirements. Coil control valve and circulation pump may not be located

above ceilings. For units which do not allow for sufficient space, provide coil piping vestibule. Vestibule shall be of similar construction to units, fully insulated, and include full size access doors.

5. Provide secondary drain pan for heating water coil circulation pump. Extend drain to unit exterior.

b. Natural Gas Heating Section:
   1. Gas units AGA-approved specifically for outdoor installation.
   2. Heat exchanger: stainless steel, forced draft blow assembly suitable for specific application.

6. Evaporative Cooling Section:
   a. Factory assembled including evaporative cooling media, reservoir, internal circulation pump, and automatic drain/fill kit.
   b. Drain/fill kit shall include outdoor air temperature sensor to automatically drain unit when outside air temperatures are below 45 degrees F, and automatically fill when outside air temperatures are above 65 degrees F.
7. Filters: Two (2”) inch throw-away filters.
8. Accessories and Options: The following factory installed options or field installed accessories shall be provided:
   a. Roof Curb. Roof mounting curb shall be of sufficient height to maintain a minimum of 12” between bottom of rooftop unit and finished roof.
   b. Specify a 115-volt convenience outlet on unit sized to handle a small power load or service light. Outlet shall be powered independently from unit power.
9. Installation
   a. Separate openings for supply and return duct (where applicable) shall be cut in roof. Annular space between roof opening and sheet metal ductwork shall be sealed. Provide Minimum of 4” acoustic insulation within roof curb. Insulation shall consist of rigid fiberglass insulation, rigid foam insulation, or fiberglass batt insulation. Joints shall be staggered and taped. In lieu of fiberglass insulation 4” thick light weight concrete may be used.
10. Controls:
    a. Refer to sections 23 09 00 and 23 09 90 for control components and sequences of operations.
11. Completion of Services
    a. Demonstration: Manufacturer’s representative shall instruct the Owner’s personnel in accordance with Section 23 05 95.
    b. Start-up: Refer Section 23 05 97.

PART 2 – PRODUCTS

A. ACCEPTABLE MANUFACTURERS
   1. Make-up Air Units:
      a. Greenheck
      b. Reznor
      c. Sterling
      d. Trane

END OF SECTION

SECTION 23 82 15

HEAT TRANSFER – HYDRONIC

PART 1 – GENERAL

A. SUMMARY – SECTION INCLUDES
   1. Convectors/Fin Tube
   2. Cabinet Heaters
   3. Unit Heaters
   4. Fan Coils
   5. Duct Coils

B. REFERENCE STANDARDS (MINIMUM CRITERIA)
   1. ARI Standard 410

C. RESTRICTIONS/CRITICAL CRITERIA
   1. Unit heaters shall utilize unitary controls. Specify unit mounted or wall mounted thermostat. Unit heater coil runs-wild and fan cycles to maintain temperatures.
   2. Coordinate with District and temperature control requirements for control of cabinet unit heaters and convectors.
      a. Cabinet unit heaters serving vestibules and entry ways shall utilize wall mounted stand-alone controls. Specify pipe mounted Aquastat to enable fan when water temperature exceeds 120 deg F. Specify wall mounted thermostat to cycle fan.
      b. Cabinet unit heaters serving occupied spaces such as classrooms, toilet rooms, and storage rooms shall utilize temperature control systems. Specify TCV and DDC thermostat.
      c. Specify DDC thermostats and TCV for convectors and fin tube to maintain space temperature in occupied spaces. In un-occupied spaces coordinate with district for means of control. Self-contained thermostatic valves may be acceptable if located below unit covers.
   3. Locate fan coil unit above accessible ceiling only. The use of fan coil unit directly above occupied spaces such as offices and classrooms is discouraged. Review fan coil unit locations with District prior to submittal of construction documents for approval.

D. SUBMITTALS
   4. Product Data:
      d. Convectors
      e. Cabinet Heaters
      f. Unit Heaters
      g. Fan Coils
      h. Duct Coils
   5. Operating and Maintenance Data:
      a. Convectors
      b. Cabinet Heaters
      c. Unit Heaters
      d. Fan Coils
      e. Duct Coils

PART 2 – PRODUCTS

A. DUCT COIL
   1. Acceptable Manufacturers:

a. Trane
b. Sigma
c. Precision Coils

2. Fins: Configured, aluminum plate fins are positioned continuously across entire coil width. Fins are die-formed in multiple stages with full fin collars for maximum fin-tube contact and accurate spacing. Fins are mechanically bonded to the tubes for lasting reliability.
3. ARI: Coils must be certified in accordance with ARI Standard 410.

B. CONVECTORS/FIN TUBE
1. Acceptable Manufacturers:
   a. Trane
   b. Sterling
   c. Vulcan
2. Minimum 16-gauge steel casing with baked enamel finish, color as selected by Architect.

C. CABINET HEATERS
1. Acceptable Manufacturers:
   a. Trane
   b. Sterling
   c. Vulcan
   d. Modine
2. Cabinet: Minimum 16-gauge steel, insulated from panel, hinged bottom panel on recessed models, tamperproof access panels and doors, stamped grills, color as selected by Architect.
3. ARI: Coils must be certified in accordance with ARI Standard 410.
4. Filters: 1” throw-away. Not required on horizontal units.

D. UNIT HEATERS
1. Acceptable Manufacturers:
   a. Trane
   b. Sterling
   c. Vulcan
   d. Modine
2. Coil: Aluminum fin on copper tube, serpentine.

E. FAN COIL
1. Acceptable Manufacturers:
   a. Trane
   b. Enviro-Tec
2. ARI: Coils must be certified in accordance with ARI Standard 410
3. Filters: 1” throw-away.
4. Cabinet: Minimum 16-gauge steel, insulated from panel, hinged bottom or side access panels, tamperproof access panels and doors.

END OF SECTION

SECTION 23 90 00

PROJECT CLOSE-OUT

PART 1 – GENERAL

A. GENERAL

1. Provisions of the General Conditions, Supplementary Conditions and Division 1 – General Requirements, and applicable provisions elsewhere in the Contract Documents that apply to the work of Divisions 21 through 23.
    a. Provisions of this Section shall also apply to all Sections of Division 21 through 23

B. WORK INCLUDED
1. The contractor shall summarize and document adherence with the requirements of the specifications for project close-out including:
    a. Copies of all Warranties
    b. Operation & Maintenance Manuals
    c. Required Tests
    d. Test & Balance Reports
    e. Project Record Documents
    f. Permit Requirements
2. The contractor shall compile a close-out manual which shall include:
    a. A list of all required test and a place for sign-off of date completed.
    b. A list of all submittals with dates of acceptance by the engineer.
    c. A schedule indicating dates for beginning testing and startup of equipment and dates of test to be witnessed by the engineer, or designated representative, as required by the specifications.
    d. Test procedures to be used for life safety systems.
    e. Project close-out check list.
3. The final close-out manual shall include the following:
    a. Test reports as required by the specifications with sign-off by the appropriate individual (engineer, architect, building official, etc.)
    b. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
    c. Copies of all warranties.
    d. Test & Balance report.
4. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

C. SUBMITTALS
1. Within 90 days after notice to proceed submit a preliminary close-out manual with the following:
    a. A list of all required tests.
    b. Preliminary schedule showing major milestones for completion of mechanical/ plumbing systems.
2. Within 30 days of the first major milestone submit the completed close-out manual as described in Part 1.
3. Within 2 weeks of substantial completion submit a completed “Project Close-Out Check List” and the Final Close-Out Manual.

D. TEST AND BALANCE REPORT
1. Balancing Report: At completion of work, submit Balancing Report.

E. PROJECT RECORD DRAWINGS
   1. General: Comply with Section 01 78 39
   2. Record the following information on Drawings:
      a. Horizontal and vertical location of underground utilities.
      b. Location of internal utilities and appurtenances concealed in construction.
      c. Field changes of dimension and detail.
      d. Changes by change order or field order.
      e. Details not on original Contract Drawings.
   3. Submittal: At completion of project, deliver Project Record Documents to General Contractor.
   4. As-Constructed Drawings: As-constructed drawings shall be provided by the mechanical contractor. As-constructed drawings shall include deviations from contract documents including all RFI's, Change Orders, ASI's, and accepted PR's as outlined in item B above. Contractor shall provide information to the design team in the form of redlined hard copy drawings or redlined electronic (PDF) files.
   5. As-Built Drawings: As-built drawings shall be provided by the Design Team. Floor plan drawings shall be same scale as the contract documents and be on AutoCAD Version 2010 or later. The drawings must comply with the following:
      a. The documents (file) must be bound complete. Drawings shall be formatted the same as the contract drawings. The drawing layers, colors and line types shall be as the contract documents.
      b. Content:
         1. Limit content to the exact information that appears on the As-constructed plot.
         2. As-constructed notation with date.
      c. Perform standard file compression and recovery until file is clean.
      d. Purge all unused tables from file.
      e. Drawing layers, colors, and line type shall be same as original contract documents.
      f. Electronic File Transfer- Acceptable Media: CD Rom.
      g. Identification Label
         1. Type of file (Display or Native).
         2. Facility and project name.
         3. Consultant or sub-consultant.
         4. Contact person.
         5. Contact person's telephone number.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Common Work Results for Electrical Systems

C. SUBMITTAL
   1. The following products require submittal
      a. Conduit and fitting
      b. Surface raceway
      c. Pull and junction box
      d. Conductor and connector
      e. Fuse
      f. Access panel
      g. Equipment identification
      h. Circuit identification
      i. Remote marquee
      j. Ground testing
      k. Compression fitting
      l. Remote marquee
      m. Power system study and associated warning sign
      n. Electronic power monitor
      o. Phase monitoring
      p. Electrical service entrance
      q. Switchboard
      r. Panelboard
      s. Dry type transformer
      t. Engine generator
      u. Automatic transfer switch
      v. Receptacle
      w. Switch
      x. Dimmer
      y. Device plate
      z. Weatherproof enclosure
      aa. Standalone occupancy and vacancy sensor
      bb. Lighting control
      cc. Perimeter raceway
      dd. Recessed floor box for slab on grade
      ee. Flush poke-through assembly
      ff. Service pole
      gg. Cord Reel
      hh. Cord Drop
      ii. Enclosed switch
      jj. Elevator disconnect
      kk. Manual motor starter
      ll. Luminaire

mm. Sound system
nn. Fire detection and alarm

D. OPERATION AND MAINTENANCE MANUALS
1. Include the following
a. All product documentation
b. All test reports
c. Letter of warranty
d. Record drawings
e. Transmittal of extra material
2. Requirements of operation and maintenance manuals
a. Review PDF
b. 3 final hard copies and one thumb drive

E. RECORD DRAWINGS
1. Requirements of record drawings
a. Keep on site during installation, include addenda, RFI's, change orders, products supplied, updated panelboard schedules (including loads), feeder conduit routing, pull/junction boxes larger than 18 by 18 inch, site underground conduits (lighting, feeders, empty conduits, and service conduits, etc.)
b. Submit to design team in hard copy or PDF

F. EXTRA MATERIAL
1. Requirements of extra material
a. Stored in original boxes (refer to individual products for quantities)
b. Transmittal with list of material to CCSD to be left at the associated building

G. METHOD OF PROCEDURE
1. Requirements for power interruption
a. Submit method of procedure for power outages
b. Scheduling of power outage one (1) month prior to proposed outage
c. Detailed method of procedure reviewed and approved two (2) weeks prior to outage

H. FEES AND PERMITS
1. Contractor responsible for fees, including utility, and permits

I. TEMPORARY LIGHTING AND POWER
1. Requirements for temporary lighting and power
a. Temporary lighting required to meet OSHA requirements when permanent lighting is not available
b. 20 ampere, 120 volt GFCI receptacle per 1500 square foot area
c. Power to construction equipment
d. Temporary fire alarm devices until replacement system is functional

J. DEMOLITION
1. Requirements for demolition
a. CCSD has the first right of refusal on removed items, if CCSD does not pick-up the items within 5 business days, then the items to be disposed of properly
b. Completely remove electrical components associated with remove equipment, unless reused for new installation

c. Regardless of why a ceiling has been removed anywhere in a building, the cables are to be supported and electrical boxes/conduits not properly supported or closed are to be corrected
d. Disposed of properly and pay associated fees for hazardous material

K. REUSE OF EXISTING EQUIPMENT
1. Requirements for reused of existing equipment
a. Maintain UL Listing
b. Clean and repair luminaires
c. Replace lamps and ballasts
d. Update panelboard directories

L. FLOOR PENETRATION
1. Requirements for floor penetration
a. On grade, seal with grouted air tight
b. Above grade, install sleeves with grouted or fire stop seal air tight

M. PENETRATION
1. Maintain fire rating

N. HOUSEKEEPING PAD
1. Requirements for housekeeping pad
a. For floor/ground mounted pad mounted transformers, switchboards, distribution panels, generators, and dry type transformers
b. 4 inches high, minimum
c. 2 inches beyond equipment supported, minimum
d. Equipment bolted to pad

O. CONTROL SYSTEM
1. Dedicated 20 ampere, 120 volt circuit per control panel connected with surge protective duplex receptacle

P. PAINTING
1. Touch up electrical equipment with matching paint to factory standard

Q. EQUIPMENT PROVIDED BY OTHERS
1. Coordinate and adjust as required for equipment provided by others

R. WARRANTY
1. Overall electrical installation to have a one (1) year warranty, refer to specific products with a longer warranty period

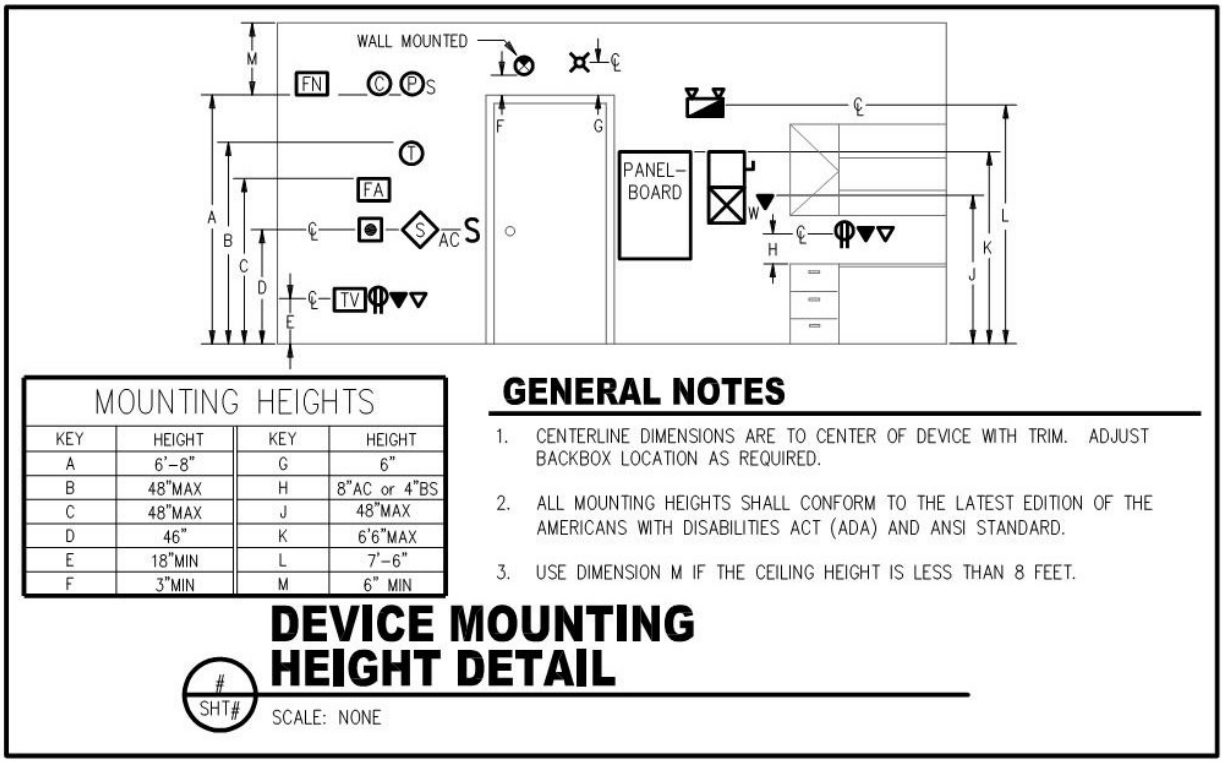
S. COMPLETION
1. Requirements for completion
a. Load balance to 10 percent between phases with updates to record drawings, junction box labels, device circuit labeling, etc.
b. Install equipment labels

T. TESTING
1. Requirements for testing
a. Self
b. Equipment manufacturer

c. Third party – Vertiv or RESA Power
d. Visual review (self)
e. Torque (self)
f. Cleanliness of equipment (self)
g. Megger test feeders (self)
h. Test and adjust dry type transformer taps (self)
i. Noise level of dry type transformers (self)
j. Ground fault interruption testing (third party)
k. Electronic trip circuit breakers (third party)
l. Ground resistance (third party)
m. Reports of testing (submitted and in operation and maintenance manuals)
n. Refer to other items for individual testing

U. COMMISSIONING
1. Requirements for commissioning
a. Witnessed and reported to CCSD
b. Lighting control systems
c. Fire alarm system
d. Generator/ATS
e. Sound systems
f. Educational intercommunication system
g. Kiln control
h. Kitchen hood/equipment control

V. MOUNTING HEIGHTS (adjust per location)



MOUNTING HEIGHTS

KEY	HEIGHT	KEY	HEIGHT
A	6'-8"	G	6"
B	48"MAX	H	8"AC or 4"BS
C	48"MAX	J	48"MAX
D	46"	K	6'6"MAX
E	18"MIN	L	7'-6"
F	3"MIN	M	6" MIN

GENERAL NOTES

1. CENTERLINE DIMENSIONS ARE TO CENTER OF DEVICE WITH TRIM. ADJUST BACKBOX LOCATION AS REQUIRED.
2. ALL MOUNTING HEIGHTS SHALL CONFORM TO THE LATEST EDITION OF THE AMERICANS WITH DISABILITIES ACT (ADA) AND ANSI STANDARD.
3. USE DIMENSION M IF THE CEILING HEIGHT IS LESS THAN 8 FEET.

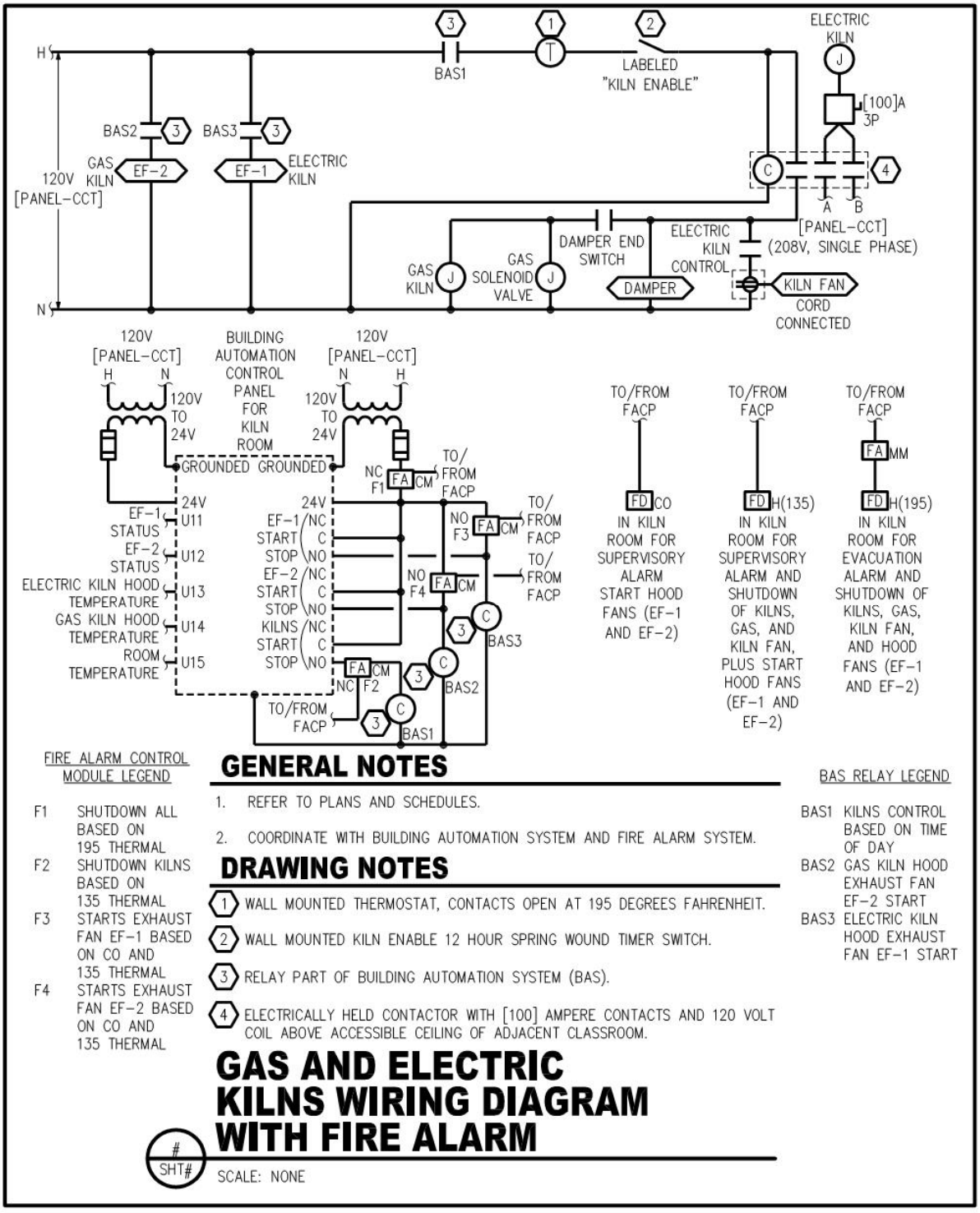
DEVICE MOUNTING HEIGHT DETAIL

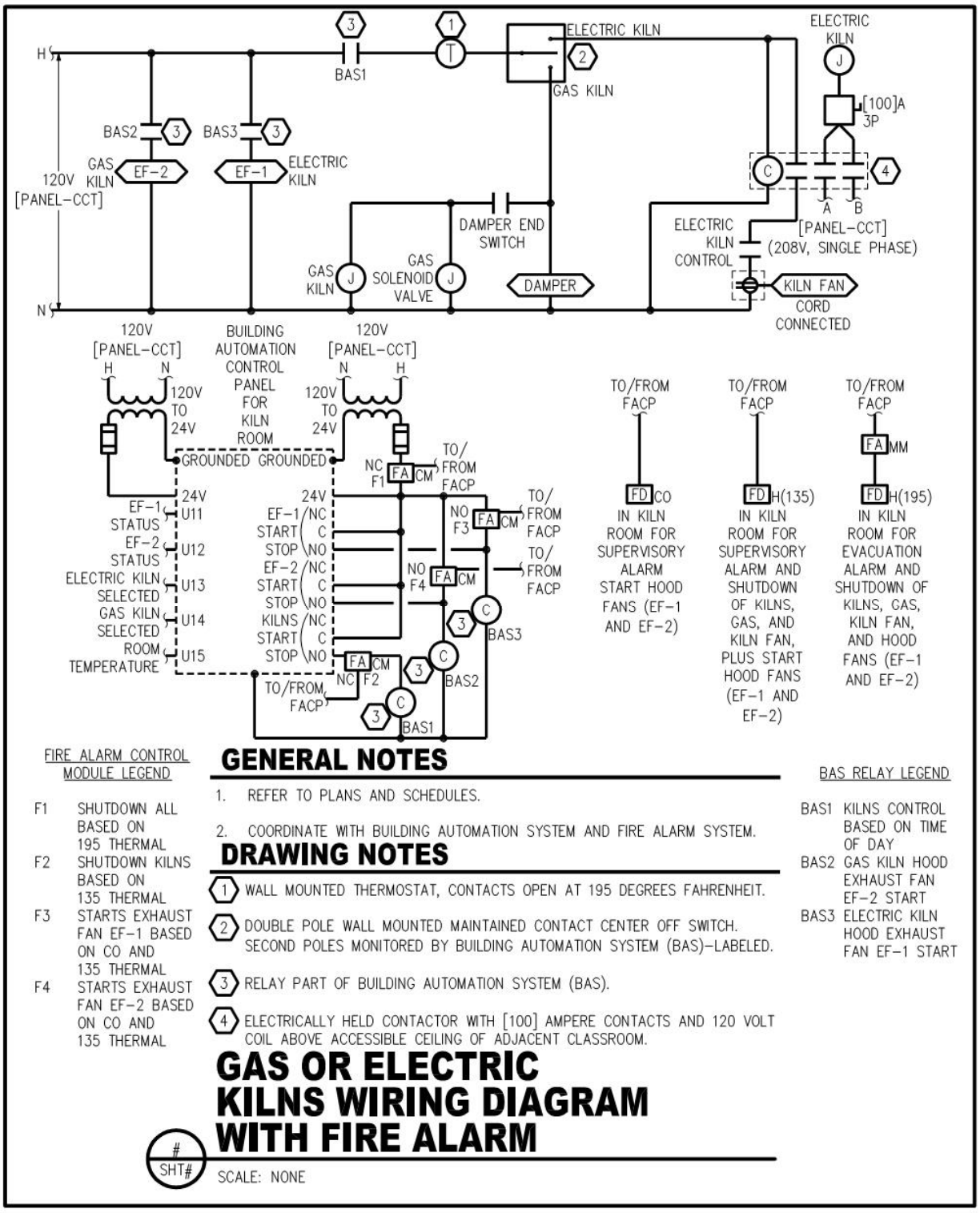
SHT#

SCALE: NONE

W. KILN CONTROL (adjust per location)

1. Kiln Control (coordinate interface with building automation system designer/installer, electrical contractor, and fire alarm design/installer, plus adjust based on kilns provided and verify with CCSD). Select which detail applies to the application.





FIRE ALARM CONTROL MODULE LEGEND

F1 SHUTDOWN ALL BASED ON 195 THERMAL
F2 SHUTDOWN KILNS BASED ON 135 THERMAL
F3 STARTS EXHAUST FAN EF-1 BASED ON CO AND 135 THERMAL
F4 STARTS EXHAUST FAN EF-2 BASED ON CO AND 135 THERMAL

GENERAL NOTES

1. REFER TO PLANS AND SCHEDULES.
2. COORDINATE WITH BUILDING AUTOMATION SYSTEM AND FIRE ALARM SYSTEM.

DRAWING NOTES

1. WALL MOUNTED THERMOSTAT, CONTACTS OPEN AT 195 DEGREES FAHRENHEIT.
2. DOUBLE POLE WALL MOUNTED MAINTAINED CONTACT CENTER OFF SWITCH. SECOND POLES MONITORED BY BUILDING AUTOMATION SYSTEM (BAS)-LABELED.
3. RELAY PART OF BUILDING AUTOMATION SYSTEM (BAS).
4. ELECTRICALLY HELD CONTACTOR WITH [100] AMPERE CONTACTS AND 120 VOLT COIL ABOVE ACCESSIBLE CEILING OF ADJACENT CLASSROOM.

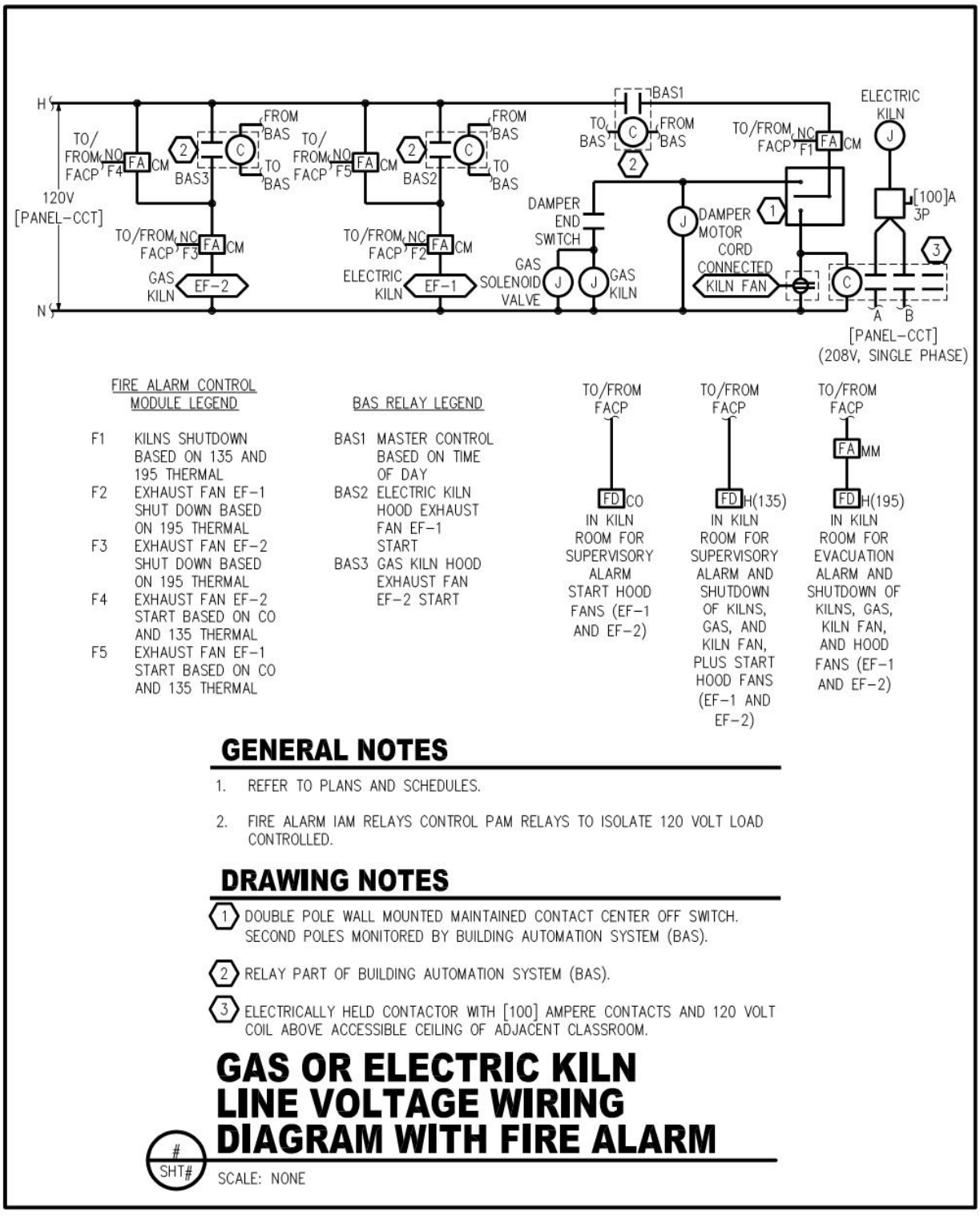
BAS RELAY LEGEND

BAS1 KILNS CONTROL BASED ON TIME OF DAY
BAS2 GAS KILN HOOD EXHAUST FAN EF-2 START
BAS3 ELECTRIC KILN HOOD EXHAUST FAN EF-1 START

GAS OR ELECTRIC KILNS WIRING DIAGRAM WITH FIRE ALARM

/ SHT#

SCALE: NONE



FIRE ALARM CONTROL MODULE LEGEND

- F1 KILNS SHUTDOWN BASED ON 135 AND 195 THERMAL
- F2 EXHAUST FAN EF-1 SHUT DOWN BASED ON 195 THERMAL
- F3 EXHAUST FAN EF-2 SHUT DOWN BASED ON 195 THERMAL
- F4 EXHAUST FAN EF-2 START BASED ON CO AND 135 THERMAL
- F5 EXHAUST FAN EF-1 START BASED ON CO AND 135 THERMAL

BAS RELAY LEGEND

- BAS1 MASTER CONTROL BASED ON TIME OF DAY
- BAS2 ELECTRIC KILN HOOD EXHAUST FAN EF-1 START
- BAS3 GAS KILN HOOD EXHAUST FAN EF-2 START

TO/FROM FACP — FD CO — IN KILN ROOM FOR SUPERVISORY ALARM START HOOD FANS (EF-1 AND EF-2)

TO/FROM FACP — FD H(135) — IN KILN ROOM FOR SUPERVISORY ALARM AND SHUTDOWN OF KILNS, GAS, AND KILN FAN, PLUS START HOOD FANS (EF-1 AND EF-2)

TO/FROM FACP — FA MM — FD H(195) — IN KILN ROOM FOR EVACUATION ALARM AND SHUTDOWN OF KILNS, GAS, KILN FAN, AND HOOD FANS (EF-1 AND EF-2)

GENERAL NOTES

1. REFER TO PLANS AND SCHEDULES.
2. FIRE ALARM IAM RELAYS CONTROL PAM RELAYS TO ISOLATE 120 VOLT LOAD CONTROLLED.

DRAWING NOTES

1. DOUBLE POLE WALL MOUNTED MAINTAINED CONTACT CENTER OFF SWITCH. SECOND POLES MONITORED BY BUILDING AUTOMATION SYSTEM (BAS).
2. RELAY PART OF BUILDING AUTOMATION SYSTEM (BAS).
3. ELECTRICALLY HELD CONTACTOR WITH [100] AMPERE CONTACTS AND 120 VOLT COIL ABOVE ACCESSIBLE CEILING OF ADJACENT CLASSROOM.

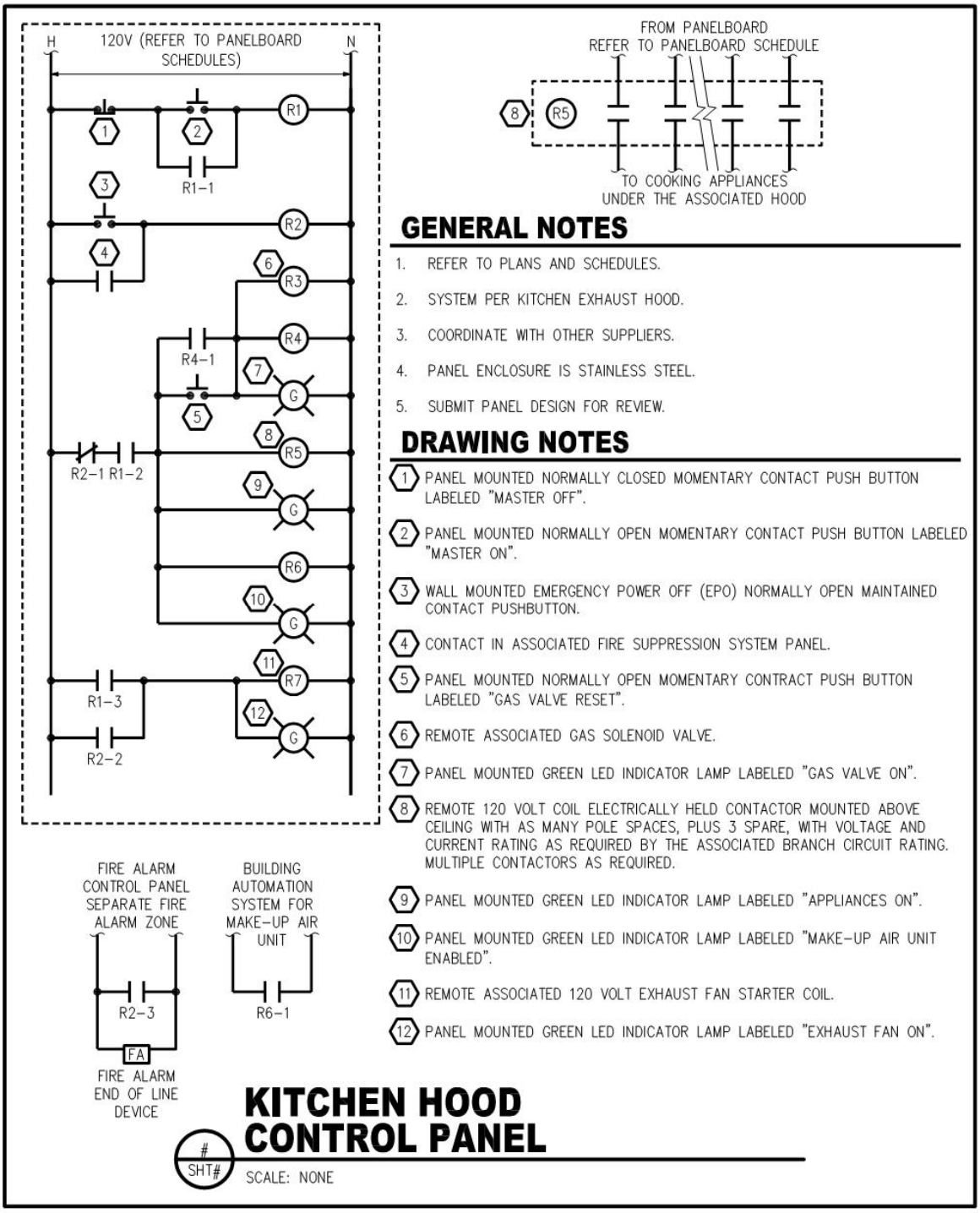
GAS OR ELECTRIC KILN LINE VOLTAGE WIRING DIAGRAM WITH FIRE ALARM

/ SHT#

SCALE: NONE

X. KITCHEN HOOD CONTROL PANEL (adjust per location)

1. Kitchen Hood Control (coordinate interface with kitchen equipment, building automation system designer/installer, electrical contractor, mechanical contractor, and fire alarm design/installer, plus adjust based on hood, kitchen equipment, and mechanical equipment provided, and verify with CCSD).



Y. REMOTE MARQUEE
1. Requirements for remote marquee
    a. Submittal
    b. Constructed on concrete footing or piers designed by structural engineer for the site wind loading
    c. Exterior structure material match building block or brick
    d. Graphic display cabinet to be energy efficient replaceable modular LED boards with a 192 by 64 pixel resolution, or as required by distance from the roadway, IP65 front, IP55 back, IP67 modules, temperature range of -40 to 158 degrees Fahrenheit, automatic dimming between sunset and sunrise, wirelessly controlled with internal memory for up to 100 messages during a 10 hour power outage, and password protected software compatible with workstation located inside building
    e. Lockable electrical disconnect
    f. Maximum 20 ampere, 120 volt service for elementary and middle school buildings
    g. Maximum 30 ampere, 120 volt service for high school buildings
    h. Wire sized for maximum of 3 percent voltage drop
    i. Installed under the supervision of a general contractor licensed in Colorado
    j. Manufacturer-employed technician or factory trained installer present during at least display installation
    k. Inspect areas in areas of work
    l. Repair all disturbed areas to original condition
    m. Clean up, maintain safety, not interfere with the typical building occupant access to the associated building, and remove waste each work day
    n. All federal, state, and local standards and codes regarding safety must be adhered to and met
    o. Prior to ordering material or starting the project verify installation, submit discrepancies in writing for consideration
    p. Comply with manufacturer's recommendations, procedures, and standards for assembly and operation of the systems, includes all equipment, hardware, materials, and methods
    q. Demonstrate acceptable system performance upon completion of the work and instruct CCSD on the programming and operation for a minimum of 2 hours

Z. COLORADO MODEL ELECTRIC READY AND SOLAR READY CODE
1. The electrical systems for new buildings to comply with the Colorado Model Electric Ready and Solar Ready Code
    a. Model Electric Ready portion within the building to include incorporation into the electrical distribution system. The electric vehicle charging portion to be supported by a separate dedicated electrical service that includes provisions for any solar ready canopies.
    b. Solar Ready portion to include provision to electrical distribution system connection. Solar panels not allowed on the roof of buildings. Dedicated shade structures or canopies to be used for solar panels. Parking area canopies system to be interfaced with the electric vehicle charging service.

END OF SECTION

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SECTION 26 05 10

BASIC ELECTRICAL MATERIALS

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Basic Electrical Materials

C. CONDUIT
   1. General requirements for conduit
      a. Submittal
      b. Routed perpendicular and parallel with building lines
      c. Concealed in finished areas (CCSD approval required for surface mounted raceways on existing concrete, masonry, or etc. surfaces, plastic raceways, Panduit type, are not unacceptable)
      d. Conduit concealed in masonry walls, minimum of 1 inch from masonry surface
      e. Include ground conductor (except for electrical service conduits)
      f. Metallic conduit electrically continuous
      g. 12 inches above ceilings
      h. Not routed on roofs without prior approval in writing from CCSD. If approved, then 12 inches above roof on B-Line DBE supports or DB_BS channel racks with roof protection under supports
      i. Not closer than 12 inches from heat sources
      j. Separate raceways for systems, voltages, and normal verses generator power
      k. Expansion joints at building expansion joints and as required to avoid contraction and expansion stresses
      l. No conduits in floor slabs and to be a minimum of 6 inches below bottom of slab
      m. Conduit bodies shall be malleable iron for metal conduit
   2. Rigid Metal Conduit
      a. Threaded fittings
      b. 3/4 inch minimum
      c. 1 inch minimum exterior
      d. PVC coated sweeps or elbows for more than 30 degree offsets underground or stub-ups or runs greater than 100 feet
      e. PVC coated minimum of 5 feet on either side of foundation or utility vault penetration
      f. Exposed exterior and wet locations
      g. Where subject to physical damage
      h. Bends for runs larger than 1-1/4 inch factory made
      i. Bends for 1 inch and 1-1/4 inch factory made or approved bending machine
      j. Ground bushings (minimum of one end of conduit) at equipment and boxes
   3. Electrical Metallic Tubing (EMT)
      a. Steel set screw connectors
      b. Rain tight compression type in crawl spaces less than 5 feet deep
      c. Uninsulated connectors with insulated bushings for larger than 1 inch
      d. 1/2 inch minimum with 3/4 inch minimum for homeruns
      e. Majority of interior
      f. Bends for runs larger than 1-1/4 inch factory made
      g. Bends for 1 inch and 1-1/4 inch factory made or approved bending machine

h. Ground bushings (minimum of one end of conduit) at equipment and boxes

4. Flexible Metal Conduit
   a. Steel continuous ground spiral
   b. Steel or malleable iron designed for the purpose fittings
   c. 1/2 inch minimum
   d. 3/8 inch minimum for luminaire whips with 18 AWG conductors
   e. Interior mechanical equipment (maximum of 3 feet)
   f. Interior dry type transformers (maximum of 3 feet)
   g. Maximum length of 6 feet or maximum of 3 feet concealed by a wall
   h. Luminaire whips
   i. Not for homeruns
5. Liquid Tight Flexible Metal Conduit
   a. Steel continuous ground spiral with oil and sunlight resistant polyvinyl chloride jacket bonded or extruded onto the exterior
   b. Steel or malleable iron designed for the purpose fittings
   c. 3/4 inch minimum
   d. 1 inch minimum exterior
   e. Exterior mechanical equipment (maximum of 6 feet)
   f. Exterior dry type transformers (maximum of 6 feet)
   g. Generators
6. Rigid Nonmetallic Conduit
   a. Schedule 40 PVC rated for use with 90 degree C wire
   b. Fittings that match the conduit
   c. 1 inch minimum
   d. Direct buried below slab on grade or exterior
   e. Concrete encased
   f. Electrical service conductors concrete encased
   g. Fittings glued
   h. PVC coated rigid metal elbows for more than 30 degree offsets underground or stub-ups or runs greater than 100 feet
   i. PVC coated rigid minimum of 5 feet on either side of foundation or utility vault penetration
   j. 30 inches below grade or 12 inches below bottom of floor slab
   k. Multiple non-concrete encased conduits to have 3 inch cover of squeegee
   l. For exterior underground power, signal, and communication lines, install continuous underground plastic line marker tape located directly above such lines. Marker shall be permanent, bright-colored, continuous-printed, vinyl tape not less than 4 mils thick by 6 inches wide with an embedded continuous metallic strip or core. Marker printing indicates type of underground line. Locate 6 to 8 inches below finished grade, unless otherwise indicated. Where multiple lines installed in a common trench or concrete encased do not exceed an overall width of 16 inches, use a single line marker with printing indicating the multiple lines. Stub ends of tape above grade at both ends.

D. SURFACE RACEWAY
   1. Requirements for surface raceway
      a. Submittal
      b. Metal only
      c. For individual circuits, Wiremold 500 or 700 series with associated components
      d. For multi-circuits, Wiremold 4000 series
      e. Used where all other options have been exhausted on existing concrete, masonry, or etc. surfaces and with approval by CCSD

E. MC CABLE
   1. Requirements for MC Cable
      a. Submittal
      b. Consist of color coded insulated conductors wrapped surrounded with a moisture resistant tape and enclosed in a galvanized steel interlocked cladding
      c. Each cable shall contain a full sized ground wire
      d. MC cable is not allowed except where specifically indicated, approved by CCSD, and only above accessible grid ceiling for 20 and 30 amperes branch circuit wiring
      e. Not used for homeruns
      f. Properly support
      g. AC cables, NM cables, modular wiring not allowed

F. PULL AND JUNCTION BOX
   1. Requirements for pull and junction box
      a. Submittal
      b. Interior, galvanized sheet metal boxes with lapped and welded joints, 3/4 inch flanges and screw covers
      c. Exterior galvanized sheet metal lapped and welded joints, 3/4 inch flanges, bolted covers with full gaskets forming a completely raintight assembly
      d. Exterior in graded, heavy duty (traffic rated where required) externally flanged for flush mounting with covers fully gasketed, watertight and secured with plated screws or bolts
      e. Interior, minimum 4 inch square, 2-1/8 inches deep
      f. Locate to maintain access
      g. Separate boxes for different voltages and for normal verses generator systems
      h. Interior, install for conduit runs longer than 100 feet
      i. Painted inside and outside to identify
      j. Label cover with associated panelboard, circuit(s), and voltage
      k. Independently supported

G. OUTLET BOX
   1. Requirements for outlet box
      a. Submittal
      b. Zinc or cadmium plated code gauge pressed steel and of the knock out type with depth to suit requirements of location
      c. Accommodate devices, conduits and conductors entering and leaving
      d. Round boxes not permitted, except where specifically indicated or to match equipment
      e. Oversized outlet boxes galvanized steel and of the knock out type with screw mounted covers for surface or flush mounting
      f. Sized as indicated or as required by the NEC. Special outlet boxes shall accommodate the equipment served
      g. Weatherproof boxes cast aluminum with threaded hubs and screw mounted, gasketed covers
      h. Interior walls, minimum 4 inch square, 2-1/8 inch deep with plaster ring
      i. IT boxes, minimum 4 inch square, 2-1/2 inch deep with plaster ring
      j. Ceilings, minimum 4 inch octagonal, 1-1/2 inch deep or 4-11/16 inch by 2-1/8 inch
      k. Masonry, minimum 2-1/2 inch by 3-3/4 inch deep single gang with plaster ring if block wall will be plastered
      l. Painted inside and outside to identify
      m. Interior walls, vertical
      n. Above counters, horizontal
      o. Receptacles within 18 inches of IT outlet

H. CONDUCTOR
   1. Requirements for conductor
      a. Submittal
      b. Aluminum conductors not allowed
      c. Minimum number 12 AWG, 98 percent conductivity copper conductors with 600 volt continuous color insulation
      d. Number 12 AWG and smaller wire except for motor circuits solid with type THHN, or THWN insulation, larger wire and motor circuit feeders stranded with type THHN, or THWN insulation
      e. Conductors for service entrance use or where used underground outside of the building type XHHW only
      f. Fire alarm wire and cable meets requirements of NEC Article 760
      g. Digital communication, network cabling, and other low voltage systems wiring compatible with system
      h. Upsize to limit voltage drop at panelboard or distribution panel to 2 percent
      i. Upsize to limit voltage drop at last device to 3 percent
      j. Coordinate conductor size with equipment lugs
      k. 8 inch slack at each outlet
      l. Maintain separation of different classes of wiring
      m. Replace existing aluminum conductors
      n. Installed in conduit, except fire alarm notification circuits, educational intercommunication system, lighting control systems, and sound systems
      o. 208Y/120V insulation colors: A (black), B (red), C (blue), Neutral (white), Ground (green), Isolated Ground (green with yellow stripe)
      p. 480Y/277V insulation colors: A (brown), B (orange), C (yellow), Neutral (gray), Ground (green)
      q. Fire detection and alarm system: speakers (red with green stripe), strobe (red with yellow stripe), power (red with purple stripe), and SLC (red with no stripe)
      r. Educational intercommunication system: Green

I. CONDUCTOR CONNECTOR
   1. Requirements for conductor connector
      a. Submittal
      b. For solid wire size number 10 and smaller, "Scotchlok" type Y, R G, or B insulated twist on spring connectors or compression type, 600 volt insulated or acceptable substitution
      c. For stranded wire number 8 to number 4, “Ilsco” type PCT mechanical tap with clear insulator
      d. For stranded wire number 3 and larger, "Burndy" long high press compression butt splice type, with heat or cold shrink sleeve
      e. No Wago connectors
      f. Installed inside of an accessible, adequately size electrical box
      g. Motor connections larger than number 10 to be Ilsco or split bolt

J. PULLING COMPOUND
   1. Requirements for pulling compound
      a. Powdered soapstone, ideal “Aqua Gel CW” or Dow Corning compound #7 wire pulling lubricant to pull conductors
      b. Use sparingly

K. LOW VOLTAGE ROUGH-IN SYSTEM COMPONENT
   1. Requirements for low voltage rough-in system component
      a. Components furnished by Others; system equipment, special outlet box receptacles, power unit cabinets, special outlet boxes, and cable
      b. 4 foot by 8 foot by 3/4 inch plywood backboards
      c. Four (4), four (4) inch conduit for underground service entrance conduit for telephone and CATV
      d. Cable supports; 2 inch diameter galvanized wide base J hooks
      e. Bridal rings for maximum of 8 cables
      f. Outlet boxes with conduit stubbed with 90 degree elbow, insulated throat bushing and pull cords to above nearest accessible ceiling or cable tray
      g. Telephone and CATV service conduits to the main equipment room

L. SUPPORT DEVICE
   1. Requirements for support device
      a. Corrosion resistant or galvanized steel supporting devices and hangers for electrical equipment from this list of Caddy Fasteners
      b. "Z" purlin clips: 1-1/4 inch maximum conduit
      c. Conduit clips: 2 inch maximum conduit
      d. Beam clamps (rod hanger clamps and vertical flange clamps) for support of threaded rod
      e. Beam clamps (set screw type): 2 inch maximum conduit
      f. Beam clamps (universal) for support of boxes and combination conduit hanger clamps
      g. Combination push in conduit clips: 1 inch maximum conduit
      h. Combination conduit hanger clamps: 2 inch maximum conduit
      i. Flexible conduit clips: 1 inch maximum flexible conduit
      j. Special combination conduit clips: 1 inch maximum conduit
      k. Two hole steel straps
      l. Conduit hangers: 4 inch maximum conduit
      m. Screw gun box brackets
      n. “H” box mounting brackets
      o. Adequately rated

M. CONDUIT SUPPORT
   1. Requirements for conduit support
      a. Single Runs: Galvanized malleable iron conduit straps for surface mounting or 1/4 inch threaded rod with steel one bolt conduit clamps for all suspended runs
      b. Multiple Runs: Unistrut or Kindorf channel support for surface mounting or trapeze style hangers of 1-5/8 inches or 13/16 inches width (depth as required) Unistrut or Kindorf painted or galvanized steel channels, supported by 3/8 inch threaded rod for all suspended runs with hangers to allow for 25 percent additional conduits
      c. Supports and hardware shall be galvanized steel, except that high carbon spring steel supports may be used in steel stud walls to support horizontal and vertical conduit up to 3/4 inch
      d. Perforated plumbing tape is not permitted in any support application
      e. Above suspended lay in ceilings, Caddy spring steel clips and dedicated red number 14 support wires may be used to support single runs of suspended electrical metallic tubing up to 3/4 inch within a single room where the structure is more than 4 feet above the level of the ceiling
      f. Use of Caddy 812MB18A allowed only where an air duct interferes with direct support to structure
      g. Coordinate requirements for seismic zone

h. Multiple conduit support rated for four (4) times the present load with a minimum 200 pounds design load
i. Support directly from structure
j. Cross bracing as required
k. Cut ends of channels painted with rust inhibiting primer

N. ANCHOR METHOD
1. Requirements for anchor method
a. Hollow Masonry: Toggle bolts or spider type expansion anchors
b. Solid Masonry (excluding concrete): Steel expansion bolts
c. New Concrete: Preset inserts with machine screws and bolts
d. Existing Concrete: Steel expansion bolts or explosive powder driven inserts
e. Wood Surfaces: Wood screws
f. Steel: Welded threaded studs or galvanized steel clamps
g. Light Steel: Sheet metal screws
h. Adequately rated
i. Verify use of explosive powder driven inserts in occupied buildings

O. FUSES
1. Requirements for anchor fuses
a. Submittal
b. Bussmann
c. Gould Shawmut
d. Littelfuse, Inc
e. Provide three (3) spare fuses for each type and rating installed
f. Provide spare fused cabinet
g. Each device with fuses labeled with phenolic or etched part of nameplate on the outside and Kroy type label inside with the fuse rating installed

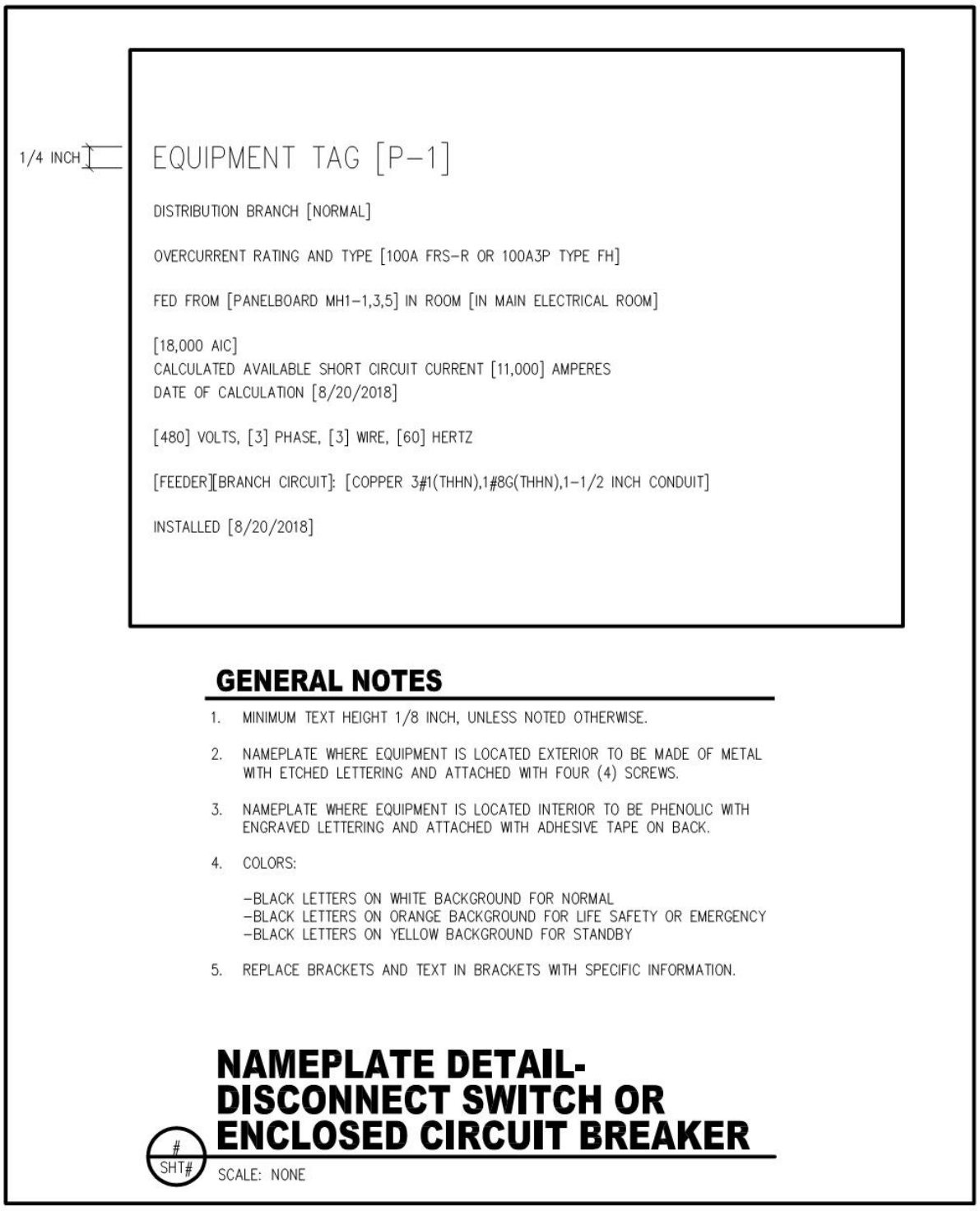
P. FIRE SEAL
1. Requirements for fire seal
a. Meet requirements of jurisdictional authority
b. Installed to maintain rating
c. Cable tray applications, fire seal shall be either a pillow or putty type allowing easy reentry and maintain specific distances between each other firmly secured to maintain this distance at penetration

Q. ACCESS PANEL
1. Requirements for access panel
a. Submittal
b. Milcor, Nystrom, Karp, J.L. Industries, or Williams Brothers
c. Milcor Style M for masonry and drywall construction; equal to Milcor Style K for plastered masonry walls and ceilings
d. Stainless steel panels used in ceramic tile or glazed structural tile
e. Doors 14 gauge minimum sheet metal, 16 gauge frames of cadmium plated or galvanized construction
f. Doors with expanded plaster rings where located in plaster walls or flanged finish where located in drywall or block construction
g. Panels spring hinges with screwdriver locks in non-public areas
h. Key lock, keyed alike, for panels in public areas
i. Prime painted or rust inhibitive paint finish
j. UL labeled when in fire rated construction, 1-1/2 hour rating

k. Minimize need by planning junction boxes and pull boxes in locations other than dry wall ceilings and walls
l. Coordinate with architect locations
m. Coordinate fire rating with installed location

R. EQUIPMENT IDENTIFICATION
1. Requirements for equipment identification
a. Submittal
b. Identify electrical equipment with permanently attached engraved phenolic or etched plates per details below, attached with minimum four (4) sheet metal screws
c. Factory nameplates attached to each piece of distribution equipment and major system component identifying manufacturer's name, address, model and serial number for each component
d. Tape Labels: Kroy type adhesive tape, with 3/8 inch black letters on white background for "normal" and red letters on white background for "emergency"
e. Dymo tape not allowed.
f. Color identification: normal power (boxes: none; labels: black with white letters), life safety (boxes: orange; labels: orange with black letters), standby (boxes: yellow or labels: yellow with black letters), UPS (boxes: black; labels: white with black letters), fire alarm (red), IT (per CCSD), educational intercommunication system (green), security (white), and sound system (per CCSD)

S. NAMEPLATE DETAILS
   1. Requirements for nameplates
      a. Submittal
      b. Include all that apply



1/2 INCH

1/4 INCH

PANELBOARD [H1A]

DISTRIBUTION BRANCH [NORMAL]

[225] AMPERE [COPPER] BUS, [FULL SIZE] NEUTRAL BUS

FED FROM [MAIN DISTRIBUTION BOARD MDB] IN ROOM [IN MAIN ELECTRICAL ROOM]

[18,000 AIC] FULLY RATED
CALCULATED AVAILABLE SHORT CIRCUIT CURRENT [11,000] AMPERES
DATE OF CALCULATION [04/06/2013]

[480Y/277] VOLTS, [3] PHASE, [4] WIRE, [60] HERTZ

FEEDER: [COPPER 4#4/0(THHN),1#4G(THHN),2-1/2 INCH CONDUIT]

COLOR CODING OF CONDUCTORS

PHASE A [BROWN]	PHASE B [ORANGE]	PHASE C [YELLOW]
NEUTRAL [GREY]	GROUND [GREEN]	

INSTALLED [08/20/2018]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:

   -BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL
   -BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY
   -BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY

5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

NAMEPLATE DETAIL-PANELBOARD

SHT#

SCALE: NONE

1/4 INCH

MAIN OVERCURRENT FOR: [PANELBOARD NAME OR DISTRIBUTION BOARD NAME]

OVERCURRENT RATING AND TYPE [225A FRS-R OR 225A3P TYPE DJ]
CIRCUIT BREAKER SETTINGS:
LT PICKUP: [1.0] LT DELAY: [4]
ST PICKUP: [2.5] ST DELAY: [0.4, I^2T ON]
INSTANTANEOUS PICKUP: [12]
GF: [0.2] GFD: [0.2, I^2T ON]

[480Y/277] VOLTS, [3] PHASE, [4] WIRE, 60 HERTZ

INSTALLED [8/20/2018]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:

   -BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL
   -BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY
   -BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY

5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

NAMEPLATE DETAIL- MAIN OVERCURRENT

SHT#

SCALE: NONE

1/2 INCH

1/4 INCH

DISTRIBUTION BOARD [MDB]

DISTRIBUTION BRANCH [NORMAL]

[4000] AMPERE [COPPER] BUS, [FULL SIZE] NEUTRAL BUS

FED FROM [XCEL PAD MOUNTED TRANSFORMER] LOCATED [SOUTHEAST OF BUILDING]

[65,000 AIC] FULLY RATED
CALCULATED AVAILABLE SHORT CIRCUIT CURRENT [42,400] AMPERES
DATE OF CALCULATION [04/06/2013]

[480Y/277] VOLTS, [3] PHASE, [4] WIRE, [60] HERTZ

FEEDER: [COPPER 11(4#500(XHHW),3-1/2 INCH CONDUIT)]

COLOR CODING OF CONDUCTORS

PHASE A [BROWN]	PHASE B [ORANGE]	PHASE C [YELLOW]
NEUTRAL [GREY]	GROUND [N/A]	

INSTALLED [08/20/2018]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:

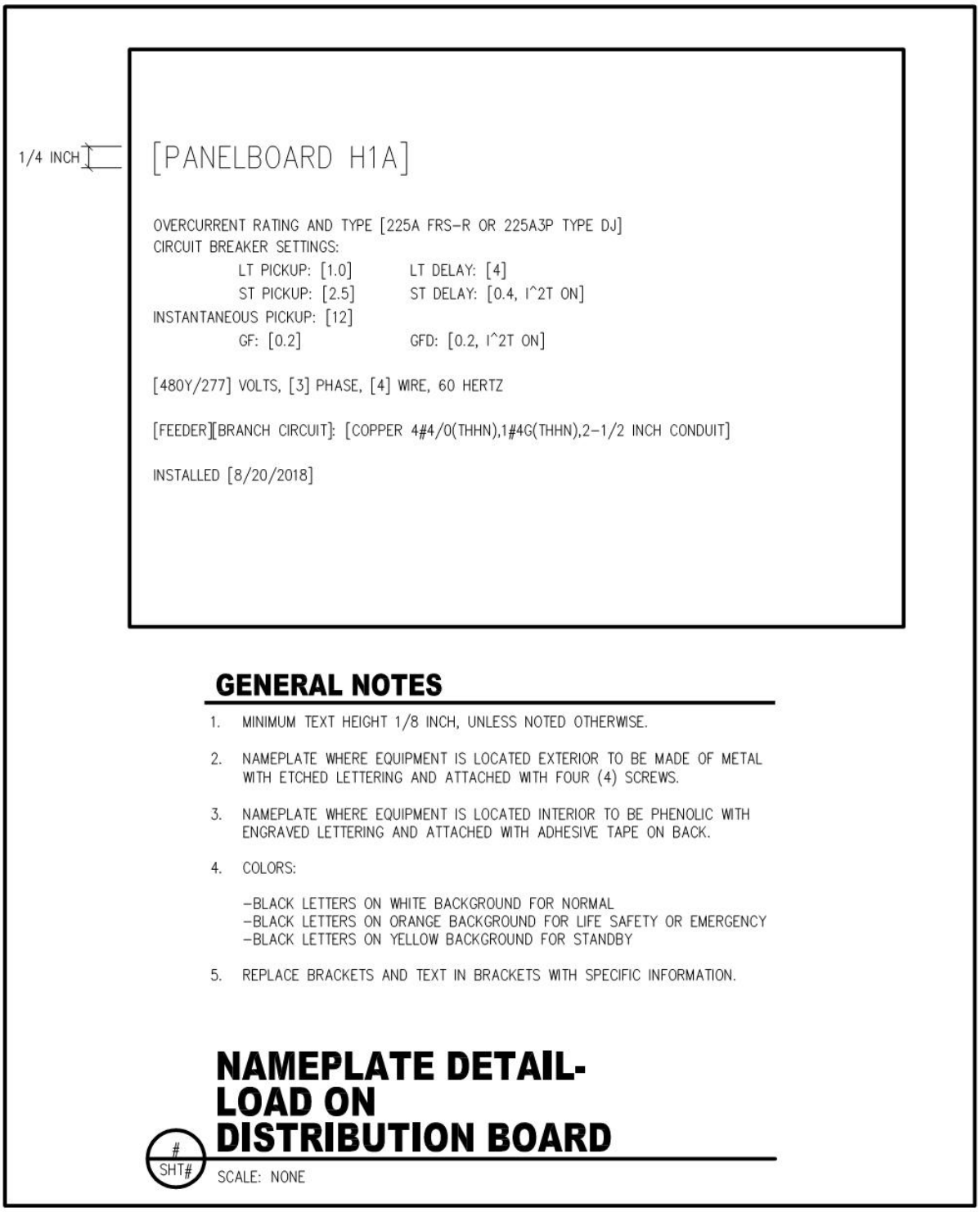
   -BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL
   -BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY
   -BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY

5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

NAMEPLATE DETAIL- DISTRIBUTION BOARD

SHT#

SCALE: NONE


1/4 INCH
[PANELBOARD H1A]
OVERCURRENT RATING AND TYPE [225A FRS-R OR 225A3P TYPE DJ]
CIRCUIT BREAKER SETTINGS:
LT PICKUP: [1.0]
LT DELAY: [4]
ST PICKUP: [2.5]
ST DELAY: [0.4, I^2T ON]
INSTANTANEOUS PICKUP: [12]
GF: [0.2]
GFD: [0.2, I^2T ON]
[480Y/277] VOLTS, [3] PHASE, [4] WIRE, 60 HERTZ
[FEEDER][BRANCH CIRCUIT]: [COPPER 4#4/0(THHN),1#4G(THHN),2-1/2 INCH CONDUIT]
INSTALLED [8/20/2018]
GENERAL NOTES
1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:
-BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL
-BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY
-BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY
5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.
NAMEPLATE DETAIL-
LOAD ON
DISTRIBUTION BOARD
#
SHT#
SCALE: NONE

1/2 INCH

TRANSFORMER [T-MDB]

[2000] KVA, [3] PHASE, [13,200] VOLTS [DELTA], 60 HERTZ IN, [480Y/277] VOLTS OUT, [60] HERTZ

FED FROM [SWITCH] LOCATED [NEAR CENTRAL PLANT]

%X: [5.25], %R: [0.86], %Z: [5.32]
CALCULATED AVAILABLE SHORT CIRCUIT CURRENT [45,200] AMPERES
DATE OF CALCULATION [04/06/2013]

FEEDER IN: [3#350(15KV) COPPER WITH TAPE SHIELD,1#4/0 GROUND(600V),4 INCH CONDUIT]

FEEDER OUT: [COPPER 11(4#500(XHHW),3-1/2 INCH CONDUIT)]

GROUND ELECTRODE CONDUCTOR: [3/0 (COPPER)]

INSTALLED [06/17/2013]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL POWER.
3. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

NAMEPLATE DETAIL- SERVICE TRANSFORMER

#
SHT#

SCALE: NONE

1/2 INCH

1/4 INCH

TRANSFORMER [KT-L1A]

DISTRIBUTION BRANCH [NORMAL]

[75] KVA, [3] PHASE, [480] VOLTS [DELTA], 60 HERTZ IN, [208Y/120] VOLTS OUT, [60] HERTZ

K-RATING: [13]

FED FROM [PANELBOARD H1A] LOCATED [IN MAIN ELECTRICAL ROOM]
LOAD [PANELBOARD L1AC] LOCATED [IN ELECTRICAL ROOM 110]

%Z: [3.00]
CALCULATED AVAILABLE SHORT CIRCUIT CURRENT [6,939] AMPERES
DATE OF CALCULATION [08/20/2018]

FEEDER IN: [3#2(THHN),1#6G(THHN),1-1/4 INCH CONDUIT]

FEEDER OUT: [3#400(THHN),2#300N(THHN),1#1G(THHN),3-1/2 INCH CONDUIT]

GROUNDING ELECTRODE CONDUCTOR: [1/0]

INSTALLED [08/20/2018]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:

   -BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL
   -BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY
   -BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY

5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

NAMEPLATE DETAIL- DRY TYPE TRANSFORMER

SHT#

SCALE: NONE

1/2 INCH

GENERATOR [GEN1]

SITE RATING: [800] KW/[1000] KVA, [3] PHASE, [480Y/277] VOLTS, [3] PHASE, [4] WIRE, [60] HERTZ

FEEDS [GENERATOR DISTRIBUTION BOARD GDB] LOCATED [IN EMERGENCY ELECTRICAL ROOM]

SUB-TRANSIANT REACTANCE: [0.12]
CALCULATED AVAILABLE SHORT CIRCUIT CURRENT [10,023] AMPERES
DATE OF CALCULATION [08/20/2018]

FEEDER OUT: [COPPER 5(4#400(XHHW),1#4/0G(XHHW),3-1/2 INCH CONDUIT)]

GROUND ELECTRODE CONDUCTOR: [3/0 (COPPER)]

NEUTRAL: [BONDED TO ENCLOSURE]

INSTALLED [08/20/2018]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:

   -BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY AND STANDBY
   OR
   -BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY ONLY

5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

NAMEPLATE DETAIL-GENERATOR

SHT#

SCALE: NONE

1/2 INCH

1/4 INCH

TRANSFER SWITCH [ATS1]

DISTRIBUTION BRANCH [LIFE SAFETY]

[100] AMPERE, [4] POLE, [480Y/277] VOLT, [3] PHASE, [60] HERTZ

NORMAL SOURCE: [MAIN DISTRIBUTION BOARD MDB] LOCATED [IN MAIN ELECTRICAL ROOM]
EMERGENCY SOURCE: [GENERATOR DISTRIBUTION BOARD GDB] LOCATED [IN EMERGENCY ELECTRICAL ROOM]
LOAD: [PANELBOARD EL1]

[30,000] AIC
CALCULATED AVAILABLE SHORT CIRCUIT CURRENT [18,550] AMPERES
DATE OF CALCULATION [08/20/2013]

NORMAL FEEDER IN:	[4#1(THHN),1#8G(THHN),2 INCH CONDUIT]
EMERGENCY FEEDER IN:	[4#1(THHN),1#8G(THHN),2 INCH CONDUIT]
FEEDER OUT:	[4#1(THHN),1#8G(THHN),2 INCH CONDUIT]

INSTALLED [08/20/2018]

GENERAL NOTES

1. MINIMUM TEXT HEIGHT 1/8 INCH, UNLESS NOTED OTHERWISE.
2. NAMEPLATE WHERE EQUIPMENT IS LOCATED EXTERIOR TO BE MADE OF METAL WITH ETCHED LETTERING AND ATTACHED WITH FOUR (4) SCREWS.
3. NAMEPLATE WHERE EQUIPMENT IS LOCATED INTERIOR TO BE PHENOLIC WITH ENGRAVED LETTERING AND ATTACHED WITH ADHESIVE TAPE ON BACK.
4. COLORS:

   -BLACK LETTERS ON WHITE BACKGROUND FOR NORMAL
   -BLACK LETTERS ON ORANGE BACKGROUND FOR LIFE SAFETY OR EMERGENCY
   -BLACK LETTERS ON YELLOW BACKGROUND FOR STANDBY

5. REPLACE BRACKETS AND TEXT IN BRACKETS WITH SPECIFIC INFORMATION.

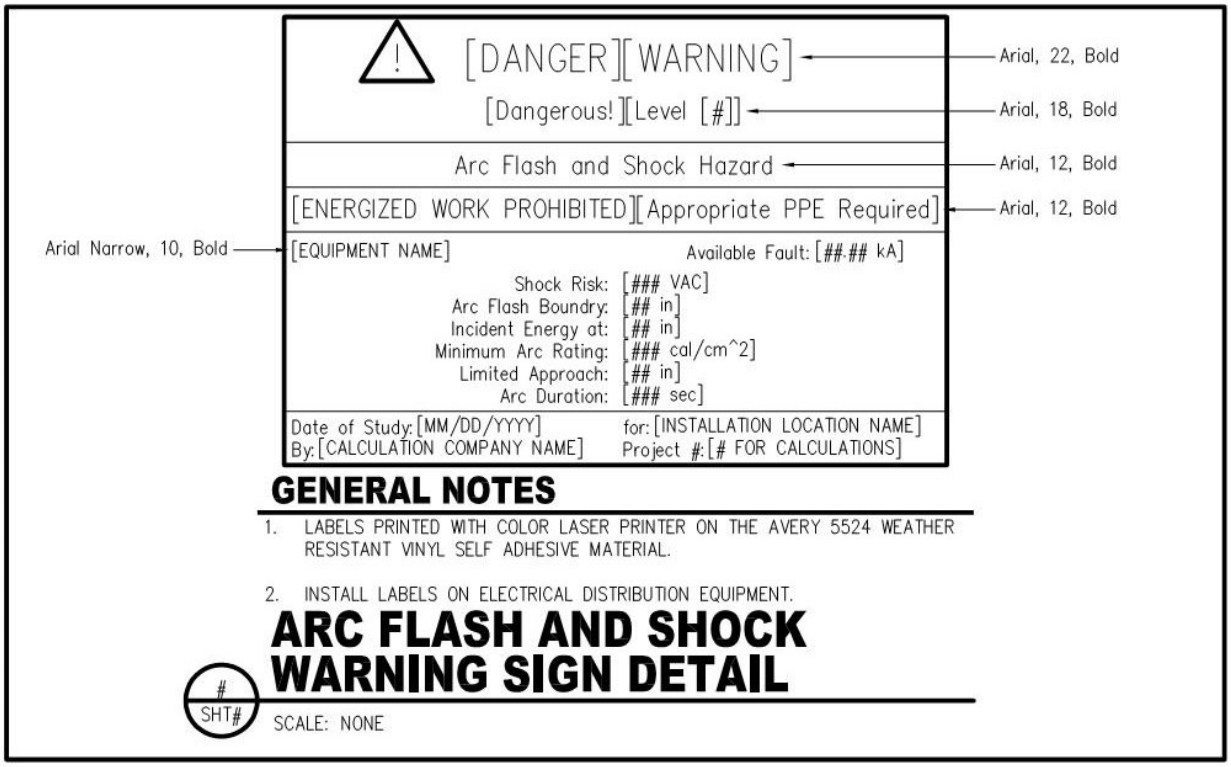
NAMEPLATE DETAIL- TRANSFER SWITCH

SHT#

SCALE: NONE

T. CIRCUIT IDENTIFICATION
   1. Requirements for circuit identification
      a. Identify feeder junction boxes and pull boxes with designation of panelboard/switchboard source as "FROM" and load served as "TO" with permanent labels
      b. Identify pull and junction boxes with the designation of panelboard, the circuit number of each circuit, and voltage contained therein, with permanent marker on box and cover
      c. Identify circuits in conduits entering outlet boxes with the designation of panelboard and the circuit number of each circuit contained therein, with permanent marker
      d. Wire and Cable Markers: Brady type permanently printed vinyl cloth adhesive backed wire markers

U. WARNING SIGN
   1. Requirements for warning sign
      a. Submittal
      b. Arc flash per detail below



END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Grounding and Bonding for Electrical Systems

C. GROUND TESTING
   1. Requirements for ground testing
      a. Submittal
      b. Independent testing agency qualifications (NETA or NRTL member)
      c. Vertiv or RESA Power
      d. Continuity
      e. Service ground less than 10 ohms

D. GROUND CONNECTION GENERAL
   1. Requirements for ground connection general
      a. Make connections so the possibility of galvanic action or electrolysis is minimized
      b. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact with earth will be galvanically compatible
      c. Use electroplated or hot tin coated materials to assure high conductivity and to make contact points closer in order of galvanic series
      d. Make connections at points of clean, bare metal

E. GROUND CLAMP AND HUB
   1. Requirements for ground clamp and hub
      a. Burndy
      b. Thomas Betts
      c. Grounding bushings, grounding studs, and grounding jumpers at switchboards, panelboards, pull boxes, and other electrical enclosures
      d. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturers published torque tightening values
      e. Ground connections to equipment and ground buses shall be by ground lugs or clamps

F. EXOTHERMIC WELD
   1. Requirements for exothermic weld
      a. Enrico Cadweld
      b. Use for connections to structural steel and for underground connections
      c. Comply with manufacturer's written instructions
      d. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable
      e. Installer shall be certified
      f. Below grade connections installed under this contract shall be left exposed for inspection by the designer prior to backfilling

G. MADE ELECTRODE
   1. Requirements for made electrode

a. Blackburn
b. Copper-clad, 120 inch long, 3/4 inch diameter
c. Moisture protection, where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable

H. COMPRESSION FITTING
1. Requirements for compression fitting
a. Submittal
b. Burndy/Hyground
c. Hydraulic compression tools to provide correct circumferential pressure for compression connectors
d. Tools and dies recommended by manufacturer of connectors
e. Embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor
f. Terminations, number 8 AWG and larger, use pressure type grounding lugs, number 10 AWG and smaller grounding conductors may be terminated with pressure type connectors

I. GENERAL GROUNDING
1. Requirements for general grounding
a. Ground connections accessible locations to allow for inspection, testing, and maintenance
b. Ground conductor in all conduits, except electrical service feeder
c. Clean all conductive surfaces on equipment to be grounded, to assure good electrical continuity
d. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage
e. Conductors shall be formed to the contour of equipment and firmly supported
f. Underground grounding conductors bury at least 24 inches below grade, if installed near the base of a structure shall be in earth and as far from the structure as the excavation permits but not closer than 6 inches
g. Metal water service pipe, dielectric main water fitting is installed, connect grounding conductor to street side of fitting no jumper across dielectric fittings
h. Water meter piping, bonding jumpers to electrically bypass water meters, connect to pipe with grounding clamp connectors
i. Grounding rods, drive until tops are 2 inches below finished floor or final grade connected by exothermic weld without damaging copper coating or exposing steel
j. Equipment grounding conductors, separate equipment grounding conductor with all feeder and branch circuit conductors, properly sized common equipment grounding conductor may be used for multiple feeders or branch circuits routed within a single conduit
k. Connect the ground terminal on each non isolated ground type outlet receptacle to the branch circuit grounding conductor and to the metallic raceway system with bonding jumpers
l. Connect the grounding stud on each luminaire to the branch circuit grounding conductor and to the metallic raceway system with bonding jumpers
m. Connections to enclosures without ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures or by grounding locknuts or bushings
n. Ground cable connections against gaskets, paint, or varnish; or on bolts holding removable access covers shall not be permitted

J. BUILDING BONDING
   1. Metallic building components, bond all metal piping, metal air ducts, and exposed interior structural steel to grounding electrode system

K. MAIN ELECTRICAL SERVICE GROUNDING
   1. Requirements for main electrical service grounding
      a. Service equipment building ground, incoming main water line with heavy duty ground clamp, tri-pod (minimum 25 feet apart) made electrodes outside foundation of building, building steel, ground loop, and Ufer
      b. Ufer ground (concrete encased grounding electrode), bond grounding conductor to reinforcing steel in at least 4 locations, and to anchor bolts and utilize footer under wall of main electrical room

L. POLE MOUNTED LUMINAIRE GROUNDING
   1. Requirements for pole mounted luminaire grounding
      a. Metal poles supporting outdoor luminaires, ground pole to metal reinforcing within concrete pole base using number 6 AWG conductor, exothermic weld or clamp connection
      b. Precast and cast concrete pole bases for metal poles supporting outdoor luminaires, ground pole to a local ground rod within 6 feet of pole base with number 6 AWG conductor, electrode, exothermic weld connection

M. LOW VOLTAGE DISTRIBUTION TRANSFORMER GROUNDING
   1. Requirements for low voltage distribution transformer grounding
      a. Copper bonding jumper to ground the secondary neutral of transformers to the secondary ground within the transformer
      b. Grounding electrode conductor to bond the secondary ground of the transformer to the closest building steel or metal water pipe
      c. Supplemental bonding to building grounding electrode system and the grounding conductor of the primary feeder

N. ISOLATION GROUNDING
   1. Isolated equipment grounding conductor, terminate at the isolated equipment grounding conductor terminal of the isolated ground bus in panelboard and to applicable derived system or service

O. GENERATOR GROUNDING
   1. Requirements for generator grounding
      a. Ground the engine generator frame and enclosure using an equipment grounding conductor
      b. Ground to made electrode (ground rod)

P. COMMUNICATION SYSTEM GROUNDING
   1. Requirements for communication system grounding
      a. Grounding means for the communication systems per the system manufacturer's recommendations
      b. Main communications service equipment grounding means minimum number 4 AWG, green, insulated, copper grounding conductor connected to the main electrical service equipment ground bus
      c. Telephone terminal boards and other remote communications equipment grounding means, but not be limited to a minimum number 6 AWG, green, insulated, copper

grounding conductor connected to the equipment ground bus in the low voltage panelboard serving the telephone equipment or branch circuits in the immediate vicinity

d. Communication equipment ground bus to be 12 inches long, 4 inches tall, 1/4 inch thick with tapped holes
e. Route the telephone equipment grounding conductors in 3/4 inch conduit by the most direct means from the telephone equipment ground bus to the electrical equipment grounding system
f. Permanent, engraved labels at the telephone equipment ground buses identifying these as the equipment grounding means and identifying the location of connection of the grounding conductors to the electrical equipment grounding system

END OF SECTION

SECTION 26 05 73

POWER SYSTEM STUDIES

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Power System Studies

C. REQUIRED INFORMATION FROM CONTRACTOR
   1. Submittals of self-adhesive weatherproof vinyl labels (Avery 5524 template)
   2. Provide distances, conduit type, circuit breaker types, etc. marked up on a comprehensive one-line diagram to project engineer, including the following
      a. Ampere rating
      b. Interrupting ampere rating
      c. Frame size, sensor or plug rating
      d. Trip settings
      e. Fault available at line terminals
      f. Ground fault interrupter trip settings
      g. Type of cable, cable size and cable length from load terminals to next termination point

D. REQUIRED FROM PROJECT ENGINEER
   1. Comprehensive list of required information for the contractor
   2. Use ETAP or SKM Systems Analysis computer program
   3. PDF file with the arc flash labels that match the detail in 26 05 00 that can be printed on Avery 5524 vinyl template sheets
   4. Label for each electrical distribution component, including multiple labels for equipment with more than one section
   5. Documentation of the settings of adjustable circuit breakers as a result of coordination study prior to required testing

E. REQUIRED INSTALLATION BY CONTRACTOR
   1. Setting of adjustable circuit breakers per project engineer coordination study prior to testing
   2. Clean surface of electrical distribution equipment and apply labels

END OF SECTION

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SECTION 26 09 15

ELECTRONIC POWER MONITOR

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Electronic Power Monitor

C. ELECTRONIC POWER MONITOR
   1. Requirements for electronic power monitor
      a. Submittal
      b. Manufactured by General Electric or Square D
      c. Current, Voltage, kW, kVA
      d. Digital communication capability, open protocol
      e. Main service equipment incoming

B. PHASE MONITORING
   1. Requirements for phase monitoring
      a. Submittal
      b. Time Mark (no equivalent)
      c. Automatic reset, three phase model 263, with appropriate voltage
      d. Connected to 20 ampere, 3 pole circuit breaker in closest to main distribution board panelboard
      e. Mounted in hinged metal box in main electrical room
      f. 3/4 inch conduit to security panel
      g. Part of service upgrades, provide new at new service and remove existing

END OF SECTION

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SECTION 26 09 43

NETWORK LIGHTING CONTROL

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Network Lighting Control

C. NETWORK LIGHTING CONTROL
   1. Requirements for network lighting control
      a. Submittal
      b. Manufactured by Acuity (nLight) or Cooper or Leviton
      c. Compatible with controlled luminaires
      d. Wireless lighting control is prohibited
      e. Includes occupancy and vacancy sensors, dimmers, switches, daylight sensors, etc.
      f. Passive infrared and ultrasonic or audio sensing dual technology products
      g. Spare components, 10 percent of each component installed, minimum of two (2)
      h. Locate sensing devices per manufacturer's recommendations
      i. Locate lighting control panels in electrical rooms
      j. Provide receptacle control in individual rooms
      k. Owners training

END OF SECTION

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SECTION 26 12 13

PAD MOUNTED LIQUID FILLED MEDIUM VOLTAGE TRANSFORMER

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Pad Mounted Liquid Filled Medium Voltage Transformer

C. PAD MOUNTED LIQUID FILLED MEDIUM VOLTAGE TRANSFORMER
   1. Requirements for pad mounted liquid filled transformer
      a. Submittal
      b. Manufactured by ABB, Cooper Power Systems (RTE), Cutler-Hammer, or Equivalent
      c. Tamperproof/lockable enclosure
      d. Concrete pad or vault
      e. Primary bushings (loop or radial feed)
      f. Load break switch actuator
      g. Bayonet or other fuse assemblies
      h. Lightning arrestors
      i. Tap changer
      j. Grounding pad
      k. Parking stands
      l. Low voltage spades
      m. Thermometer
      n. Vacuum gage
      o. Pressure relief device
      p. Drain valve with sampling device
      q. Environmentally safe liquid
      r. Voltages as required
      s. 95 kV BIL
      t. Minimum impedance 2 percent
      u. Maximum impedance 4 percent
      v. 185 degree Celsius windings (aluminum or copper)
      w. Copper terminal lug landings and bus extensions
      x. Grounding pads in opposite corners of the field wiring sections
      y. Cooling fans as required
      z. Olive green highly resistant to corrosion paint
      aa. Tested

END OF SECTION

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SECTION 26 12 19

ELECTRICAL SERVICE ENTRANCE

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Electrical Service Entrance

C. ELECTRICAL SERVICE ENTRANCE
   1. Requirements for electrical service entrance
      a. Submittal
      b. Manufactured by American Midwest Power or Erickson Electrical Equipment Company
      c. Connection cabinet for XCEL service area
      d. EUSERC cabinet for Core service area
      e. Plated copper buses
      f. Minimum of 65,000 AIC or greater as required
      g. Mounted on concrete pad
      h. Utility metering exterior of building

END OF SECTION

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SECTION 26 22 00

DRY TYPE TRANSFORMER

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Dry Type Transformer

C. DRY TYPE TRANSFORMER
   1. Requirements for dry type transformer
      a. Verify with CCSD if the dry type transformer(s) is/are Owner furnished/contractor installed or contractor provided
      b. Submittal
      c. Manufactured by Powersmiths or Mirus (no equivalent)
      d. Copper or aluminum windings
      e. Maximum 115 degree Celsius rise windings
      f. K-9 rated for all transformers, except K-13 rated for transformers supporting a majority of electronic equipment
      g. Meet current energy code
      h. NEMA 1 enclosures typical, rain shield for transformers located on the exterior or wet location
      i. Floor mounted on concrete pad and rubber vibration absorbing mounts
      j. Suspended 75 kVA or less with CCSD review of suspension method
      k. Secondary overcurrent protection of a single device
      l. The maximum sound level rating of 0.5 to 9 kVA - 40 dBa, 10 to 50 kVA - 45 dBa, 51 to 150 kVA - 50 dBa, 151 to 300 kVA - 55 dBa, 301 to 500 kVA - 60 dBa
      m. Replace noisy transformers

END OF SECTION

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SECTION 26 24 13

SWITCHBOARD

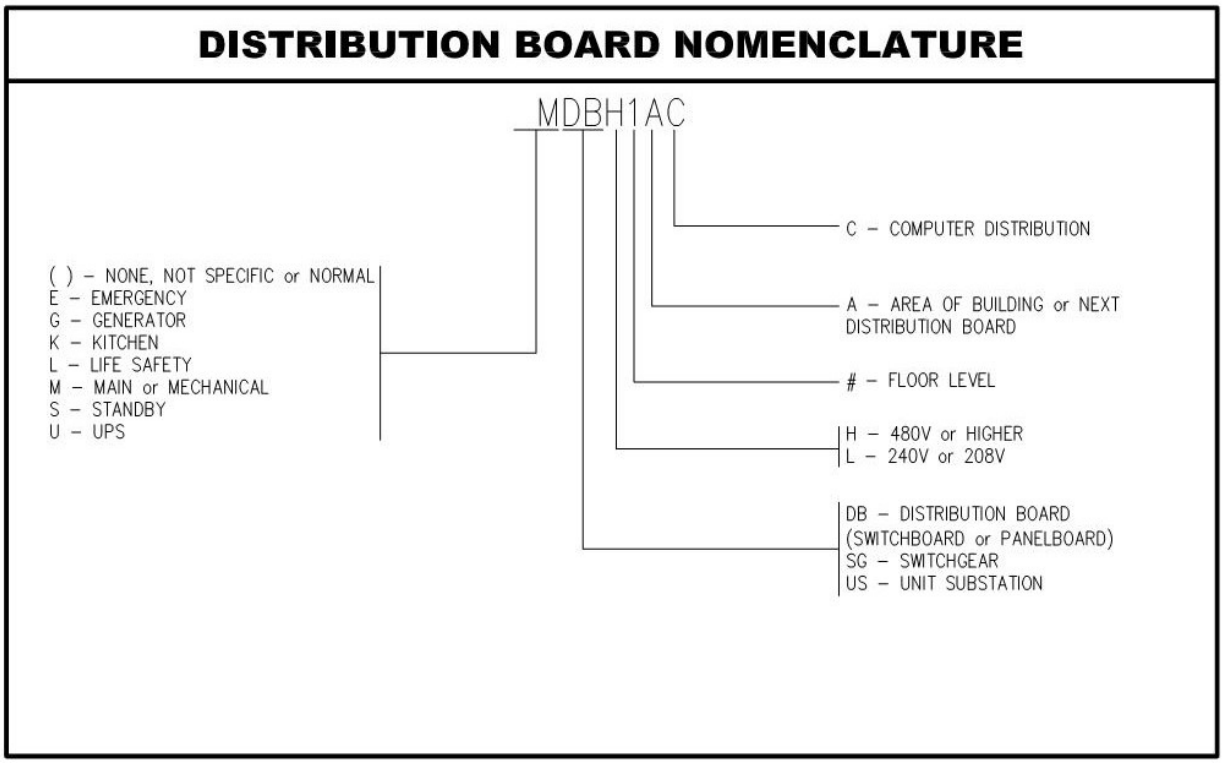
PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Switchboard

C. SWITCHBOARD
   1. Requirements for switchboard
      a. Submittal
      b. Manufactured by ABB, Square D and Siemens (no equivalent)
      c. Main service entrance distribution equipment or sub-distribution equipment
      d. Plated copper buses
      e. Main protective devices 800 amperes and larger, adjustable trip circuit breaker with (where required) ground fault
      f. Branch protective devices 250 amperes and larger, 80 percent rated electronic trip circuit breakers with long time, short time, instantaneous, ground fault (where required) trip devices
      g. Circuit breakers with frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker
      h. Minimum of 50,000 AIC or greater as required
      i. Mounted on concrete pad
      j. Setting of devices per power system studies
      k. Main located in dedicated electrical room or on the exterior of the building with utility metering
      l. No conduits shall penetrate the top of a NEMA 3R switchboard

m. Nomenclature per below



END OF SECTION

SECTION 26 24 16

PANELBOARD

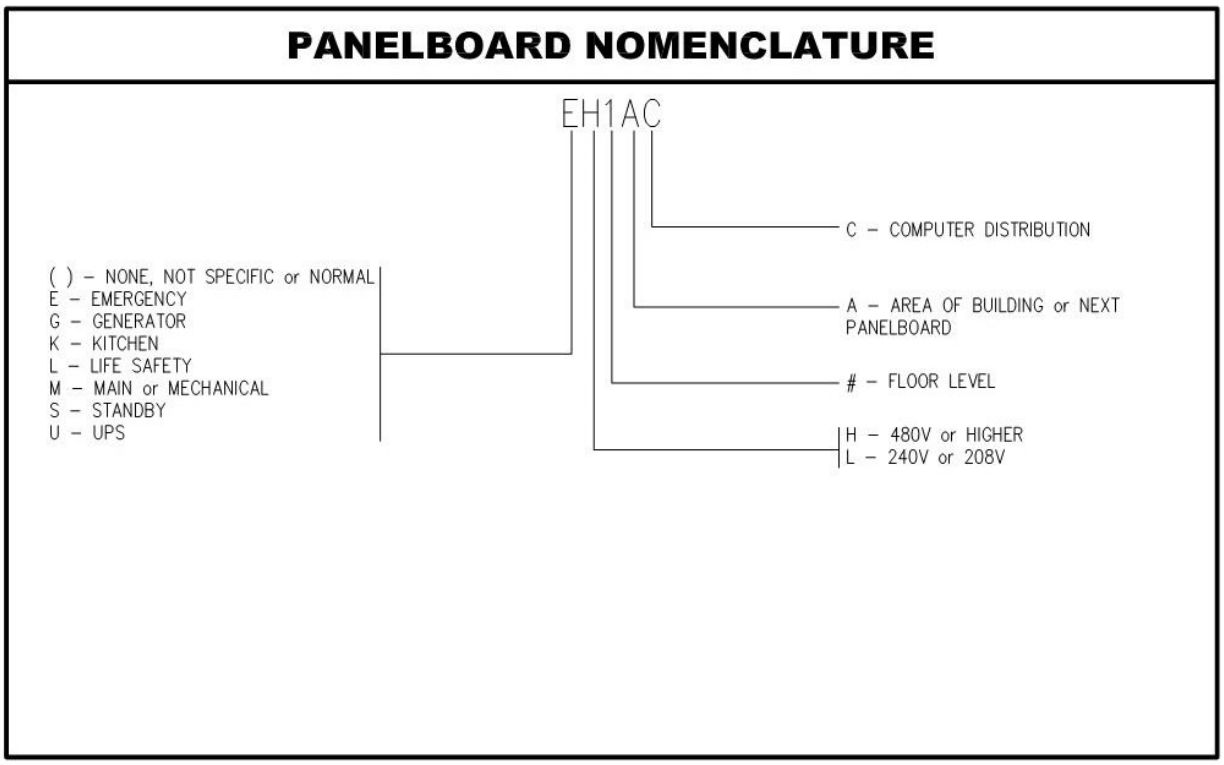
PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Panelboard

C. PANELBOARD
   1. Requirements for panelboard
      a. Submittal
      b. Manufactured by ABB or Square D or Siemens (no equivalent)
      c. 208Y/120V (ABB-ReliaGear or Square D-N series or Siemens-P series)
      d. 480Y/277V branch panelboards (ABB-ReliaGear or Square D-N series or Siemen-P series)
      e. Distribution circuit breaker panelboard (ABB-ReliaGear neXT, Square D-I-Line type or Siemens-P series)
      f. Fusible switch type distribution panelboards (ABB, or Square D-type QMB or Siemens-P series)
      g. 100 percent rated copper busing
      h. 200 percent rated neutral busing for panelboards supporting majority of electronic equipment
      i. 100 percent rated isolation ground bus where used
      j. Bolt on circuit breakers
      k. Circuit breakers with frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker
      l. Hinged trim covers for branch circuit panelboards
      m. Multi-section panelboards same height
      n. NEMA 1 enclosures typically, NEMA 3R for wet or exterior locations, or NEMA 12 in pool equipment rooms
      o. Full height busing
      p. Fully rated AIC
      q. Flush mounting to maintain fire rating of wall
      r. Spare conduits stubbed to above accessible ceiling with 90 degrees, capped for flush mounted panelboards equal to 10 percent of the installed conduits
      s. Panelboard directories with type written description of loads with spares and spaces written with pencil
      t. New designs to include 20 percent spare capacity, 10 percent spare circuit breakers and 10 percent spaces
      u. Located in dedicated electrical room, except in kitchens, laboratories, or mechanical rooms
      v. No conduits shall penetrate the top of a NEMA 3R panelboard

w. Nomenclature per below



END OF SECTION

SECTION 26 27 26

WIRING DEVICES AND DELIVERY SYSTEMS

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Receptacle, Switch, Dimmer, Device Plate, Weatherproof Enclosure, Stand Alone Occupancy and Vacancy Sensor, Perimeter Raceway, Floor Box, In Floor Raceway or One Floor Raceway, Recessed Floor Box for Slab on Grade, Flush Poke-Through Assembly, Service Pole, Cord Reel, and Cord Drop

C. RECEPTACLE
   1. Requirements for receptacle
      a. Submittal
      b. Manufactured by Cooper Wiring Devices, Hubbell, Leviton, or Pass and Seymour
      c. Color gray typically (adjust per existing), red for life safety, brown for standby, orange for isolated ground, black for surge protective device, blue for automatic receptacle control
      d. Premium specification grade, 20 ampere minimum
      e. No integral USB ports
      f. Tamper resistant type
      g. Mount vertically 18 inches above finished floor or grade typically (adjust to nearest block course)
      h. Mounted horizontal 4 inches above counter backsplash
      i. Installed with ground connection up where vertical and ground connection to the left for horizontal
      j. Special devices to match load
      k. Weather resistant duplex mounted on roof, connected dedicated circuit from 208Y/120V panelboard (not mechanical equipment), in weatherproof enclosure (weatherproof while in use cover)
      l. Energy code automatically controlled receptacles with labeling:
         1. General: Wall mounted receptacles to be double duplex outlets with one (1) duplex continuously powered and other than blue, and one (1) duplex controlled as outlined with contactors located in electrical rooms
         2. Individual rooms, controlled via occupancy sensor power pack
         3. Individual rooms with existing wireless lighting control via contactor(s) interfaced with building automation system
         4. Large open areas with modular furniture control shared neutral circuits with contactor(s) interfaced with building automation system and wall mounted 2 hour override timer switch (leaving the dedicated neutral circuit for computer CPU’s only continuously powered)
         5. All wall mounted monitors, displays, and projectors controlled via dedicated contactor(s) interfaced with building automation system

D. SWITCH
   1. Requirements for switch
      a. Submittal
      b. Manufactured by Cooper Wiring Devices, Hubbell, Leviton, or Pass and Seymour
      c. Color gray typically (adjust per existing), red for life safety, clear with red pilot light (pilot light load on), clear with white illuminated handle (pilot light load off)

d. Premium specification grade, 20 ampere minimum
e. Mounted within 18 inches of the door jamb
f. Mounted 46 inches to center above finished floor
g. Pilot light load on for control of equipment
h. Pilot light load off in mechanical and electrical rooms

E. DIMMER
1. Requirements for dimmer
a. Submittal
b. Compatible with LED luminaire being controlled
c. Gray color (adjust per existing)
d. Pushbuttons to raise and lower with separate on/off switch
e. Spare devices of 10 percent with a minimum of two (2)
f. Other requirements refer to switch

F. DEVICE PLATE
1. Requirements for device plate
a. Submittal
b. Manufactured by Cooper Wiring Devices, Hubbell, Leviton, or Pass and Seymour
c. Stainless steel
d. Panelboard and circuit number labeled on inside with permanent marker and outside with Kroy type labeling

G. WEATHERPROOF ENCLOSURE
1. Requirements for weatherproof enclosure
a. Submittal
b. Manufactured by Hubbell, Pass and Seymour, Taymac, Thomas and Betts, or Raco
c. NEMA 3R rating while in use
d. Metallic die cast alloy 360 copper-free aluminum baked lacquer finish
e. For devices mounted on the roof and other locations subject to water from above
f. Panelboard and circuit number labeled on inside with Kroy type labeling

H. STAND ALONE OCCUPANCY AND VACANCY SENSOR
1. Requirements for stand alone occupancy and vacancy sensor
a. Submittal
b. Manufactured by Acuity or Wattstopper
c. Passive infrared and ultrasonic or audio sensing dual technology products
d. Appropriate for the location and application
e. Manual on for vacancy sensors
f. Auxiliary contacts
g. Daylight sensing
h. Spare devices of 10 percent with a minimum of two (2)
i. Wall box type vacancy sensors in small rooms
j. Ceiling mounted most areas
k. All, except egress and exit lighting, controlled by occupancy and vacancy sensors
l. Ceiling devices connected ahead of wall switch manual control with maintenance switch ahead of sensor
m. Auxiliary contacts for interface with building automation system and automatically connected receptacles

I. PERIMETER RACEWAY
   1. Requirements for perimeter raceway
      a. Submittal
      b. Multi-channel steel finished in gray suitable for field repainting
      c. Duplex device spacing indicated on drawings
      d. Includes communication section with devices indicated on drawings
      e. Plugmold multi-outlet assemblies not allowed
      f. Continuous lengths
      g. Two (2) 3/4 inch conduits from communication section per end stubbed to above accessible ceiling
      h. Maximum of 4 duplex receptacles per circuit wired alternately in long lengths

J. FLOOR BOX
   1. Requirements for floor box
      a. Not allowed

K. IN FLOOR RACEWAY OR ON FLOOR RACEWAY
   1. Requirements for in floor raceway or on floor raceway
      a. Not allowed

L. RECESSED FLOOR BOX FOR SLAB ON GRADE
   1. Requirements for recessed floor box for slab on grade
      a. Submittal
      b. Cast iron with number of gangs indicated on drawings
      c. Brushed aluminum cover with cord training openings
      d. No plastic trim pieces allowed
      e. Devices as indicated
      f. Minimum 1-1/4 inch conduit from communication section per 4 devices stubbed to above accessible ceiling of the same floor level
      g. Coordinate locations with floor construction

M. RECESSED POKE-THROUGH ASSEMBLY
   1. Requirements for recessed poke-through assembly
      a. Submittal
      b. Fire rated assembly
      c. Flush aluminum flange
      d. Devices as indicated and recessed under a hinged brushed aluminum cover with cord training opening
      e. No plastic trim pieces allowed
      f. Minimum of 3/4 inch conduit from communication devices stubbed to above accessible ceiling of the floor level below
      g. Gray or black

N. SERVICE POLE
   1. Requirements for service pole
      a. Submittal
      b. Steel with gray or ivory finish
      c. Height to 6 inches above ceiling
      d. Devices as indicated
      e. Connections above ceiling

O. CORD REEL
    1. Requirements for cord reel
        a. Submittal
        b. Manufactured by Molex/Woodhead
        c. Two (2) 20 ampere, GFCI protected receptacles connected with twist lock receptacle at ceiling
        d. Strain relief at receptacle box
        e. Standard duty Model 998L Series in classrooms
        f. Industrial duty Model 9383 Series in shops
        g. Where mounted in accessible ceiling areas use brushed stainless steel plate ceiling tile

P. CORD DROP
    1. Requirements for cord drop
        a. Submittal
        b. SO cord with two (2) 20 ampere, GFCI protected receptacles connected with twist lock receptacle at ceiling
        c. Strain relief at receptacle box and connection at ceiling
        d. Where mounted in accessible ceiling areas use brushed stainless steel plate ceiling tile

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCH

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Enclosed Switch

C. ENCLOSED SWITCH
   1. Requirements for enclosed switch
      a. Submittal
      b. Manufactured by ABB, Siemens, and Square D
      c. Heavy duty, 100 percent duty rated
      d. NEMA 1 enclosures typically, NEMA 3R for wet or exterior locations, or NEMA 4X in kitchens
      e. Open auxiliary contacts when switch is open for VFD interface

D. ELEVATOR DISCONNECT
   1. Requirements for elevator disconnect
      a. Submittal
      b. Manufactured by Bussmann
      c. NEMA 4 enclosure
      d. Type LPJ fuses
      e. Shunt-trip power monitor relay
      f. Pilot light
      g. Open auxiliary contacts when switch is open
      h. Locate within 18 inches of machine room door jamb
      i. Monitor shunt-trip power relay and auxiliary contacts with fire alarm

END OF SECTION

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SECTION 26 29 13

MOTOR STARTER

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Motor Starter

C. MAGNETIC MOTOR STARTER
   1. Requirements for magnet motor starter
      a. Supplied by others
      b. Installed by electrical contractor
      c. Labeled with load controlled and panelboard and circuit

D. MANUAL MOTOR STARTER
   1. Requirements for manual motor starter
      a. Submittal
      b. Manufactured by Allen Bradley, General Electric, or Siemens
      c. Thermal overloads (where indicated) matched to load controlled
      d. Pilot light
      e. Mounted adjacent to equipment
      f. Labeled with load protected, panelboard, and circuit

END OF SECTION

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SECTION 26 32 13

ENGINE GENERATOR SYSTEM

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Engine Generator System

C. ENGINE GENERATOR SYSTEM
   1. Requirements for engine generator system
      a. Submittal
      b. Manufactured by Caterpillar, Cummins/Onan, Generac, Rehlko
      c. Natural gas engine with submittal of Department of Regulatory Agencies “NATURAL GAS AS AN ALTERNATE FUEL SOURCE” document
      d. 105 degree Celsius rated windings
      e. Neutral bonded to housing
      f. Sound attenuated weather resistant enclosure
      g. Rodent resistant enclosure
      h. Site rated
      i. Starting aids such as battery warming pads, block heater, etc.
      j. Permanent magnet type alternator
      k. Battery charger at generator
      l. Digital remote annunciator
      m. Located on concrete pad on exterior of building
      n. Overcurrent coordinated
      o. Provision for Temporary Generator Connection Cabinet Dual Purpose Docking Station (Trystar TMTS-5 or equivalent)
         i NEMA 3R enclosure
         ii Male Camlok connections for portable generator
         iii Female Camlok connections for load bank
         iv Manual 3 (three) position transfer switch
         v Phase rotation monitor
         vi Engine auto start diverter switch/remote start contacts
         vii Battery charger receptacle: NEMA 5-20R, GFCI, 20A, 120V
         viii Block heater receptacle: NEMA L5-30R, 30A 120V
         ix Automatic load dump receptacle
      p. EPO located on building near engine generator
      q. Factory start-up
      r. 4 hour load bank testing with single step
      s. Training
      t. Remote annunciator located in building engineer’s office and at fire department building entrance

u. Remote annunciator NFPA 110 includes alarms, sounder activation (lamp color-flashing where indicated) and other components: Overspeed, sound (red), Low Oil Pressure, sound (red), Pre-Low Oil Pressure, sound (red), High Engine Temp, sound (red), Pre-High Engine Temp, sound (amber), Low Coolant Temp, sound (red), Failure to Start, sound (red), Weak Battery, sound (red), Low Battery Voltage, sound (red), High Battery Voltage, sound (amber), Genset Running (amber), Not In Auto, sound (red-flashing), Check Genset (amber), Low Fuel Level, sound (red), Low Coolant Level, sound (amber), Charger AC Failure, sound (amber), Genset Supplying Load (amber), Customer Fault 1 (red), Customer Fault 2 (amber), Customer Fault 3 (red), Network Status Lamp (red), silence/lamp test button, and horn.

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCH

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Transfer Switch

C. TRANSFER SWITCH
   1. Requirements for transfer switch
      a. Submittal
      b. Manufactured by ASCO, Caterpillar, Cummins/Onan, ABB/Zenith, Generac, Rehlko
      c. 4 pole
      d. 3 per position auxiliary contracts
      e. Testing with engine generator
      f. Touch screen on cover to adjust user settings
      g. Buildings required to have continuous occupancy the automatic transfer switches to have bypass isolation switch for life safety loads, confirm with CCSD buildings with continuous occupancy
      h. Programming of exercise clock for 30 minute runtime with the following two (2) sequence: 1) once every 30 days with load transfer and 2) once every 7 days without load transfer

END OF SECTION

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SECTION 26 43 13

SURGE PROTECTIVE DEVICE

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Surge Protective Device

C. SURGE PROTECTIVE DEVICE
   1. Requirements for surge protective device
      a. Submittal
      b. Main service device Current Technology SL3-300 (no equivalent) disconnect, surge counter, indicator lights, test port, and 20 year warranty
      c. Generator distribution surge protective device ABB OVRHT3C50 or equivalent
      d. Receptacle device from manufacturer of receptacles
      e. Main service device tapped to bus with 4#2,1#2G,1-1/2”C maximum of 10 feet cable length with minimal bends
      f. Generator distribution surge protective device connected to 20 ampere, 3 pole circuit breaker in the first panelboard downstream of the automatic transfer switch mounted adjacent to panelboard protected

END OF SECTION

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SECTION 26 50 00

LIGHTING

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Lighting

C. LIGHTING
   1. Requirements for lighting
      a. Submittal
      b. Manufactured by well-known manufacturer, all manufacturers approved by CCSD
      c. Manufactured by those indicated on luminaire schedule
      d. LED light sources with minimum 5 year material and labor warranty
      e. 4000K color temperature
      f. 80 CRI for most uses with 90 CRI in art rooms and dressing rooms
      g. Limited glare
      h. Dimmable
      i. Exit signs cast aluminum with green letters
      j. Pole mounted on pole base designed by structural engineer
      k. Exterior mounting heights and light trespass to meet local lighting ordinance with a backlight rating that minimizes light trespass and glare, an up light rating of 0, and a maximum glare rating of 2
      l. Spare drivers and LED boards of 10 percent with a minimum of two (2) per luminaire type
      m. Spare UL 924 relays of 10 percent of installed components with minimum of two (2)
      n. Interior lighting, except egress and exit lighting, controlled by occupancy and vacancy sensors
      o. All exterior building mounted luminaires connected to generator
      p. Egress luminaires indicated with an adjacent red sticker
      q. Interior luminaires in most rooms, except storage, and equipment, to have dimming
      r. Instructional spaces with generator powered luminaires to be controlled with other lighting via UL 924 relay
      s. Manual lighting control in all interior locations
      t. Exterior lighting controlled by building automation system via contactors with manual over-ride switch labeled
      u. Illumination levels and requirements to comply with Code of Colorado Regulations for instructional and general use areas
      v. Illumination levels for kitchens to be minimum of 50 footcandles
      w. Illumination for elevator equipment rooms and pits to meet the requirements of ANSI
      x. Interior lighting maximum of 3 to 1 maximum to minimum
      y. Egress lighting per Code with no greater than 40 to 1 maximum to minimum
      z. Illumination levels for parking and exterior walkway areas to be minimum of 0.2 footcandles, 20 to 1 maximum to minimum, and 4 to 1 average to minimum
      aa. Illumination levels for building entrances 2 footcandle average, and maximum of 5 footcandles
      bb. Pass COMcheck
      cc. Interior daylight and occupancy control per energy code

dd. Energy code automatically time controlled lighting contactors located in electrical rooms, contactor(s) interfaced with building automation system, and wall mounted maximum two (2) hour override switches for interior lighting
ee. Energy code lighting metering
    i. New buildings, metered electrical distribution to include dedicated lighting panelboards
    ii. Renovated building, metered via lighting control system
ff. Exterior area lighting with motion controlled dimming per energy code, use the maximum amount of allowed energy so that at 50 percent power the surveillance cameras are effective

END OF SECTION

SECTION 27 10 00

STRUCTURED CABLING

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. PURPOSE
   1. The purpose of this document is to provide design guidelines for architects, engineers, consultants, and contractors with an understanding of the minimum requirements for Telecommunications Infrastructure and other Technology systems for any building related project within the Cherry Creek School District (CCSD). If the building is existing, the requirements outlined below should be met to best of the ability of the design team and/or contractor. If the building is new construction, the requirements outlined below must be adhered to unless written approval is provided from CCSD IST prior to design completion.

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. SUMMARY – SECTION INCLUDES
   1. Structured Cabling

E. STRUCTURED CABLING
   1. Requirements for structured cabling system
      a. Submittal
      b. Approved Cabling Contractors

American Datapath 2345 South Platte River Drive Denver, CO 80223 Phone: 303-922-8887 Contact: Kristin Newman Kristin@americandatapath.com	C-COMM, LLC 14 Inverness Drive East, Suite G-132 Englewood, CO 80112 Phone: 303-478-7858 Contact: Marty Cederstrom mcederstrom@c-comm.com
JNL Communications 8200 East Pacific Place, Unit 104 Denver, CO 80231 Phone: 303-587-8374 Contact: Jeff Downing Jdowning@jnlcs.com	National Network Services 6840 North Broadway Denver, CO 80221 Phone: 720-737-4737 Contact: Jeff Bowlus Jeff.bowlus@nnsi.net

Rocky Mountain Telecom & Data 13401 W 43rd Dr., Unit 12 Golden, CO 80403 Phone: 303-534-6022 Contact: Damian Difeo ddfeo@rmtd.net	Piper Communication Services 5960 North Jay Street Arvada, CO 80003 Phone: 303-456-1060 Contact: Carin Avila-Darr carin@pipercommunications.com
GigaSpan Solutions Inc 8200 South Akron Street, Suite 115 Centennial, CO 80012 Phone: 303-284-3453 Contact: Jon Getz jon.getz@gigsspan.com	IES Communications 109 Inverness Drive East, Unit G Englewood, CO 80112 Phone: 303-505-9244 Contact: Anthony Pratt anthony.pratt@iescomm.com

c. Telecom rooms
   1. Telecom Rooms provide dedicated space for telecommunications cabling as well as other CCSD IST approved systems equipment. These rooms shall not be allowed to double as electrical or mechanical rooms nor shall they be allowed to be used as storage rooms, janitor's closets, or other non-technology related use. In addition, under no circumstance shall any Telecom Room house any equipment not serving the space including mechanical ductwork, electrical gear, transformers, piping or any plumbing or other liquid carrying apparatus etc.
   2. There are three (3) basic types of telecom rooms. They are Building Entrance Facility (BEF), Main Distribution Frame (MDF), and Intermediate Distribution Frame (IDF).
      i. The BEF is the room (only if not in the MDF) where the service provider such as CenturyLink or Comcast terminates their equipment and cabling which provides building access to the outside world. From this point, the main cross connect (MC) resides which then runs to the MDF. This room typically houses wall mounted or rack mounted equipment provided by the service provider, however the engineer/consultant shall coordinate with the service provider on what the expected equipment will be and if the service provider requires CCSD to provide any equipment racks and if so what size and quantity. The engineer/consultant will also coordinate pathway needs to enter the BEF.

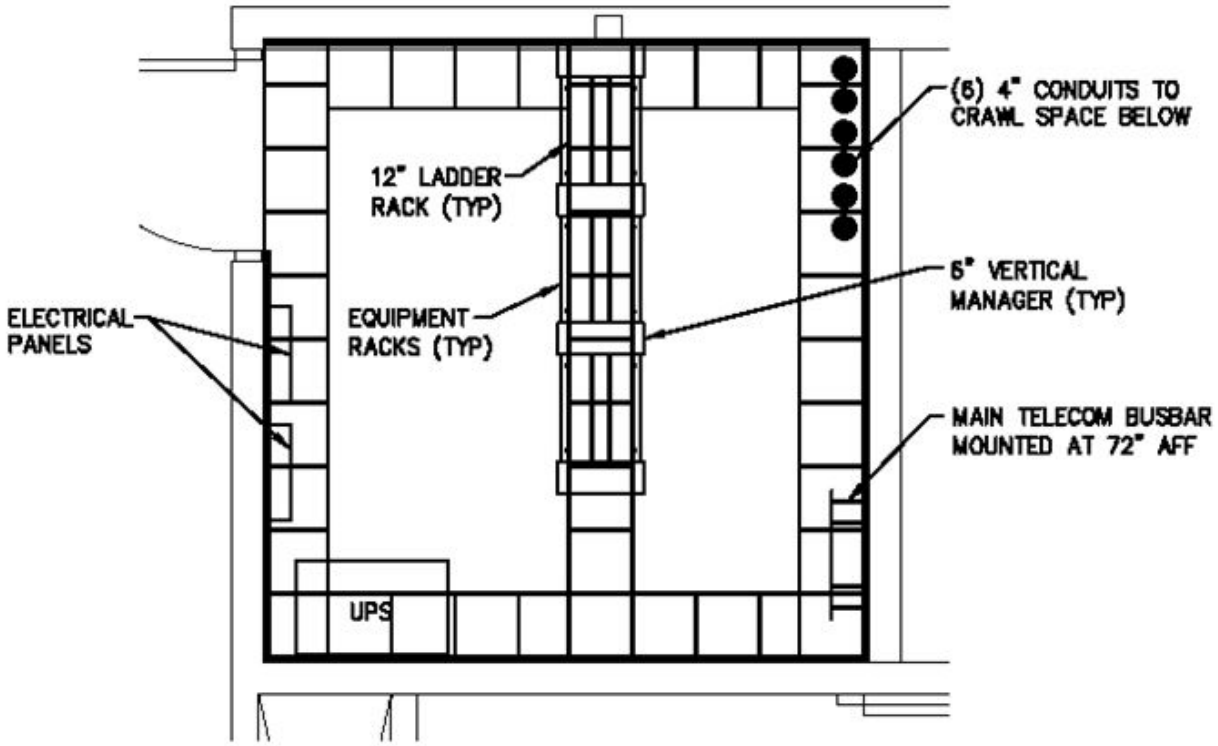
ii. The MDF (could contain the BEF equipment and MC as well) is the room that houses the main telecom equipment for the building. There is typically only one per building, however a second may exist if a dedicated server room is ever needed. The MDF is typically where all of the main equipment such as data core switches, phone systems, servers as well as other equipment reside. If there is more than one (1) MDF space in the building all additional IDF rooms act as intermediate cross connect locations (IC). The backbone cabling distribute from the MDF in a star configuration to each of the outlying IDF's. In addition, the MDF can act as the location for the horizontal cross connect (HC) in which horizontal cabling distributes out to the individual outlet workstation locations. If this room is the only one (1) in the building, then this room will act as the location for the MC and HC with no IC needed. In addition, the main access control panel is often located in this room as well as potentially building automation system (BAS) controls, and overhead paging system. Expect the IDF's to have a minimum of two equipment racks for small buildings, however the room may be required to be larger depending on how much equipment is planned for the room. The design team shall coordinate the size of the room, with a minimum of 10 feet by 10 feet floor space, during the design phase and shall be coordinated with CCSD IST prior to final construction documents being issued.

iii. The IDF rooms house outlying telecom equipment when additional rooms beyond the MDF are needed because the distance from outlet to IDF for the horizontal cabling exceeds 295 feet. The main intent for IDF rooms is to act is a location for HC's for the outlying portions of the building; however these rooms can also hold equipment for access control and building automation system (BAS) controls. IDF's are typically only required to have one (1) equipment rack and the size of this space shall be developed during the design phase with a minimum room size of 8 feet by 10 feet; however additional racks maybe required and should be coordinated with CCSD IST prior to final construction documents.

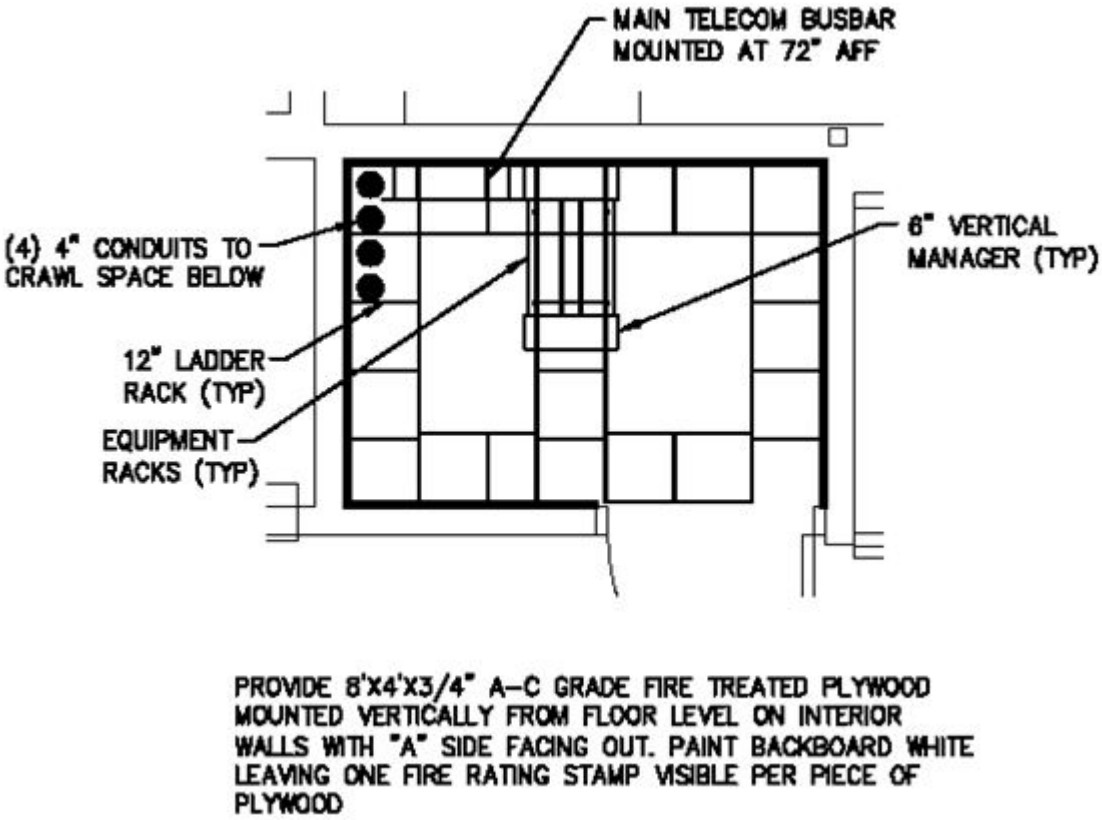
3. For all telecom spaces (BEF, MDF, and IDF's) each room should have the door swing out. In addition, each room shall have a static dissipative VCT tile or similar. Unless specifically requested by CCSD IST, telecom spaces shall be open to structure. Each telecom room shall have 3/4 inch by 4 feet by 8 feet A-C grade backboard (A side facing out) with a minimum of two coats of white fire retardant paint on all four (4 walls. Each room is expected to have a minimum of 3 feet clearance on three (3) sides of the row of equipment racks. This includes clearance from any equipment mounted on the wall dedicated for other low voltage systems. If there is more than one (1) floor, an IDF shall be located on each floor and shall be stacked unless CCSD IST provides written approval otherwise.
4. The rooms shall be laid out using one (1) row of standard seven foot high, two post, relay racks with 6 inch vertical managers in-between and on the ends of the rack row. The racks shall have a deep channel. These racks shall hold owner provided server equipment, switch gear, routers, and phone system equipment. In addition, the racks shall have the termination point for the fiber backbone cable as well as patch panels to support the horizontal cabling terminated in the room. Ladder rack shall be mounted around the perimeter as well as down the center above the equipment racks allowing for proper cable management. All racks, ladder rack, and cable managers shall be manufactured by Chatsworth and are black in color.

5. Verify with CCSD IST during design, but the power requirements in each room is as follows.
    i. A 30 ampere, 120 volt receptacle installed at the base of each equipment rack
    ii. Two (2) 20 ampere receptacles, each with a dedicated circuit, installed on the ladder rack facing the back side of each equipment rack. Each of these receptacles are required to be on emergency power if available.
    iii. Double duplex convenience receptacles shall be installed around the perimeter of the room approximately every 6 feet on center.
6. Telecom room shall have a dedicated cooling system unit. Rooms may only require a transfer fan, however the final cooling requirements shall be based off of the expected cooling load in the room and should be confirmed with CCSD IST during the design phase of the project. Cooling requirements will meet or exceed BICSI Best Practices.
7. Lighting for the room shall consist of luminaires on the front and back of the row of equipment racks. The lighting shall provide a minimum of 30 footcandles at 1 foot above the finished floor.
8. Grounding for the BEF and MDF shall have a 20 inch by 4 inch by 1/4 inch copper main telecom ground bus bar (MTGB) using a #6 AWG ground wire bonded to building ground or the main electrical ground bar. The IDF's shall have a similar bus bar but 10 inch by 4 inch by 1/4 inch bus bar and shall be tied back to the MTGB via a minimum #6 AWG ground wire.

9. The MDF room layout as below.



10. The IDF rooms layout as below.



d. Pathway requirements
   1. The pathways for each of the technology systems infrastructure shall be designed and installed in accordance with the latest ANSI/EIA/TIA/CCSD standards, and the National Fire Protection Association (NFPA) – all applicable standards. Each conduit shall be fitted with an appropriate plastic bushing and run to accessible ceiling space unless otherwise noted.

2. Pathways shall mainly consist of a combination of wire basket type cable tray, J-hooks, and EMT conduit. All outlets shall have a standard 4-11/16 inch square deep back box with single gang mud reducer and a 1 inch conduit stubbed to accessible ceiling space or to the nearest cable tray. No power poles shall be used in any CCSD space unless approved by CCSD IST as well as CCSD Facilities during the design phase of the project. Where cabling is run above the ceiling, it shall be supported by J-hooks spaced no more than 5 feet apart in route to the nearest cable tray or to the nearest telecom room. Cabling shall be supported directly by the structure, not by mechanical ductwork, piping, electrical supports. When crossing electrical wiring, the structured cabling shall cross at a perpendicular angle to the electrical wiring. All code and standard requirements for distances for telecom cabling and infrastructure from sources of EMI such as transformers, fluorescent lights, copiers, etc. shall be observed and shall follow BICSI Best Practices. Cable tray shall be installed in locations where large quantities of cables are consolidated into one (1) pathway and run back to either the telecom room or the conduit riser pathway leading back to the nearest telecom room. Cable tray shall be supported using either a trapeze mounted from the ceiling structure or using L-brackets if wall mounted. The cable tray shall not be supported by the center of the tray. Where cable tray is installed, it shall be located in main corridors where possible, however due to conflicts with low height HVAC feeder ducts, some tray may require running through other areas with accessible ceiling. Conduit concealed in finished areas (CCSD approval required for surface mounted raceways on existing concrete, masonry, or etc. surfaces, plastic raceways, Panduit type, are not unacceptable).
3. For new construction, a minimum of two (2) 4 inch conduits shall be run from the BEF to the nearest service provider pedestal or manhole. It is the design team's responsibility to coordinate the conduit routing and final termination point with the service provider during the design phase of the project. If there is more than one (1) IDF in the building, the outlying IDF's shall be tied back to the MDF using a minimum of three (3) 4 inch conduits. One (1) conduit shall be dedicated for fiber backbone and two (2) spare. All conduits shall be labeled for telecom cabling and shall not be used for any other systems without prior approval from CCSD IST. If telecom rooms are stacked on multiple floors, four (4) 4 inch conduit sleeves shall be provided between the rooms. One (1) conduit shall be dedicated for fiber backbone, one (1) for horizontal cabling running between floors (such as cabling running from poke- through devices on the same floor to the accessible ceiling space below) and two (2) spare.
4. Conduit sleeves shall be provided through rated walls for all system wiring not specified being in conduit. Conduit segments between endpoints/pull boxes shall not exceed 100 feet, nor contain more than a total of 180 degrees of bends. L-bend devices shall not be used in any circumstances for any structured cabling pathways. All fire-rated wall penetration must be properly made and sealed according to National Electric Code (NEC) and National Fire Protection Association (NFPA) using approved Underwriters Laboratories (UL) methods and materials and following BICSI Best Practices.
5. For new construction, two (2) 2 inch conduits with weatherheads shall be run from the top IDF to the roof for cabling to support a future satellite connection to support a television distribution system or a distributed antenna system (DAS).

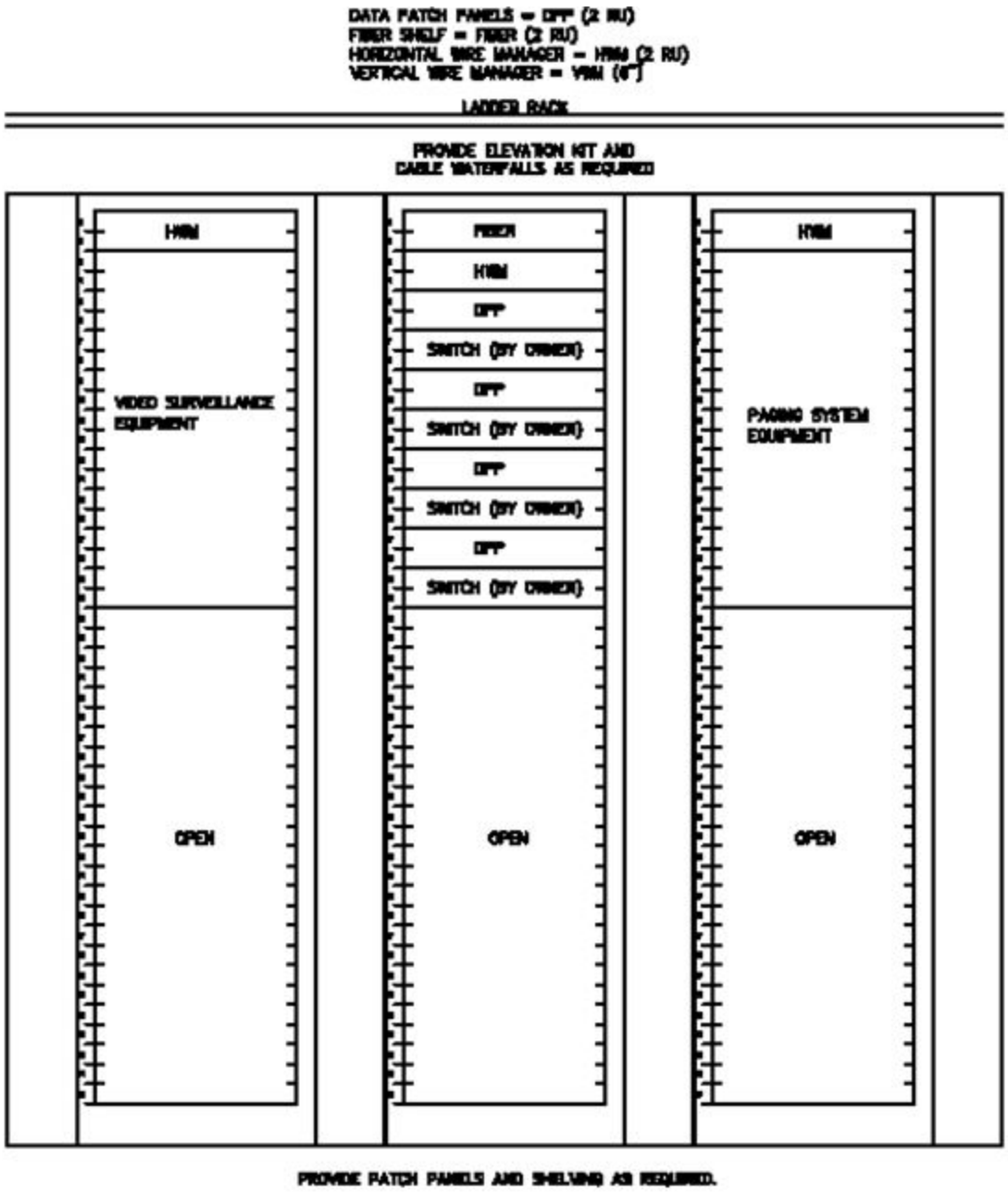
6. The engineer/consultant is responsible for communicating in the construction documents that the following power separation requirements are maintained:
    i. Distribution cabling shall not be alongside power lines, or share the same conduit, channel, or sleeve with electrical apparatus.
    ii. Voice and data cables must route in the designated cable pathways within the furniture systems. These must be separated from the electrical feeds.
    iii. Cable trays must be installed in such a manner that all installed copper communications cabling can be routed to maintain EIA/TIA and BICSI standards for keeping the proper distances away from EMI/RFI producing devices, alternating current power cables, motors, transformers, fluorescent lighting ballasts, and other EMI/RFI generating equipment. High voltage, high emissions equipment may require greater distances.

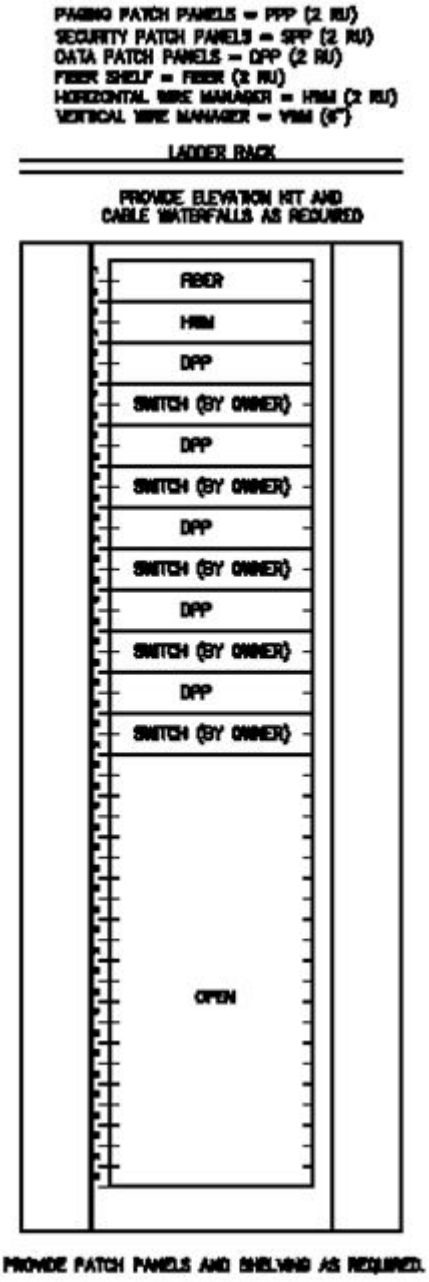
e. Backbone cabling
    1. The backbone cabling is the cabling that connects the IDF's back to the MDF and again from the MDF to the BEF. The backbone shall consist of both fiber. The fiber backbone cabling shall consist of 12 strand armored singlemode fiber optic cable running from the MDF to each outlying IDF.
    2. All fiber optic cabling shall be terminated on rack mounted 1U or 2U enclosures mounted in the equipment racks. The enclosures shall have 12 strand SC adapter panels at both ends.
    3. CCSD IST has standardized on Commscope Net Connect products for the fiber, terminations, and enclosures.

f. Horizontal cabling
    1. The horizontal cabling is the cabling that connects each outlet located throughout the building back to the nearest IDF. The horizontal cabling system consists of patch panels, Category 6 cabling, and RJ-45 jacks at each telecom outlet faceplate. CCSD IST has standardized on Commscope TE products for an end to end horizontal cabling infrastructure. All cabling for voice, data, video surveillance, wireless access points (WAP), and building automation systems (BAS) controls, and IP paging speakers shall have Category 6 horizontal cabling. Cabling shall be plenum rated where required by code. All cabling shall be terminated on standard RJ-45 jacks at the faceplate and on RJ-45 jacks in standard, not discrete, two rack unit (RU) 48 port modular patch panels mounted in the equipment racks in the telecom room.
        i. Always for new construction and whenever possible in renovations, cabling for video surveillance, wireless access points, and IP speakers will need to be evenly distributed across all installed patch panels. The horizontal cabling shall be designed and installed in accordance with the latest ANSI/EIA/TIA standards, and the National Fire Protection Association (NFPA) BICSI Best Practices – all applicable standards. All horizontal cable runs shall be limited to 295 feet (90 meters) in length.
            (1) At the patch panel; voice/data and building automation system (BAS) controls cabling shall be white in color with black jacks
            (2) At the patch panel; video surveillance cabling shall be yellow in color with yellow jacks
            (3) At the patch panel; paging system cabling shall be green in color with green jacks
            (4) At the patch panel; WAP cabling shall be blue in color with blue jacks
            (5) At the wall plate jacks should all be orange

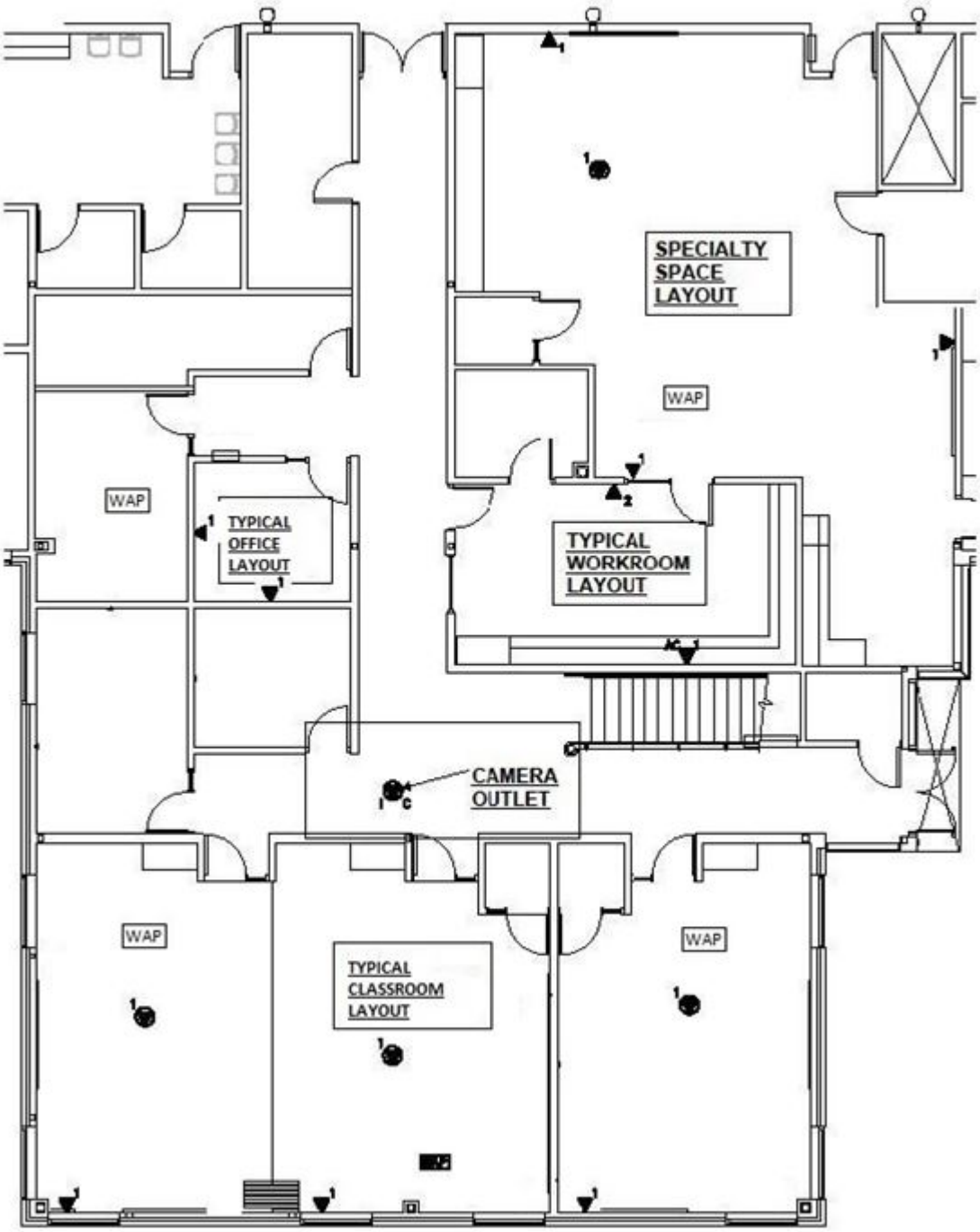
2. CCSD has standardized on voice over internet protocol (VoIP) phones and therefore each standard data outlet shall consist of only one (1) Category 6 cable. Floor locations require a minimum of two cables and in some cases four (4) cables may be required. The final cable counts for each location are to be coordinated with the architect, furniture, and CCSD IST during design to ensure the district's needs are met. All wireless outlet locations will consist of one (1) Category 6 cable each. Video surveillance cameras and IP paging speakers each require one (1) Category 6 cable as well. See additional paging system requirements located in the overhead paging system section 27 51 13. There are other non-standard outlets that will serve specific specialty systems such as wall phones, building automation system (BAS) controls, and some audio video equipment. The cable quantities for these outlets shall be specific to those systems and locations and shall be coordinated throughout the design process. Outlets dedicated for wall phones shall be mounted at 48 inches AFF and have a stainless steel faceplate with two mounting studs to support a wall mounted phone.
3. Classrooms shall have typically centered on one (1) single gang WAP outlet allocated for every classroom. For non-classroom spaces, WAP outlets shall be spaced consistent with the lasted industry standards and to provide 100 percent coverage throughout the building. Cable service loops (25 feet) shall be provided at each to accommodate adjustments in the locations during coverage testing and shall be terminated in the field on RJ-45 jacks housed in a biscuit box. Floor locations shall be coordinated with the furniture and architect during design.
4. It is expected that CCSD IST will provide all patch cords, however this should be confirmed during the design phase with CCSD IST.

5. Patch panels in the telecom rooms supporting the horizontal cabling shall be laid out using a 2U panel with 2U of empty rack space configuration in the equipment racks. The 2U open space is dedicated for CCSD provided network switchgear. All rack configurations shall be confirmed with CCSD IST prior to final construction documents being issued by the design team. Refer to below for a typical rack elevation configuration.




PAGING PATCH PANELS = PPP (2 RU)
SECURITY PATCH PANELS = SPP (2 RU)
DATA PATCH PANELS = DPP (2 RU)
FIBER SHELF = FIBER (2 RU)
HORIZONTAL WIRE MANAGER = HWM (2 RU)
VERTICAL WIRE MANAGER = VWM (6")
LADDER RACK
PROVIDE ELEVATION KIT AND CABLE WATERFALLS AS REQUIRED
FIBER
HWM
DPP
SWITCH (BY OWNER)
DPP
SWITCH (BY OWNER)
DPP
SWITCH (BY OWNER)
DPP
SWITCH (BY OWNER)
DPP
SWITCH (BY OWNER)
OPEN
PROVIDE PATCH PANELS AND SHELVING AS REQUIRED.

6. Refer to typical outlet layout below.



g. Testing
    1. The design team shall be responsible for ensuring that all cabling is tested by the contractor and test results are submitted in the appropriate formats. In addition, the design team shall be responsible for reviewing all test results and coordinating with the cabling contractor on any non-compliant test results. All copper cable to be tested and all test results must comply with the specifications of ANSI/EIA/TIA 568- C.1 and C.2, including TSB-155, Additional Guidelines for 4-pair Category 6 cabling for 1GBase-T Applications. Category 6 cables tested for 250 MHz operation for the ANSI/EIA/TIA Category 6 standard. Testing will include the end-to-end link.
    2. Test equipment shall be suitable for certifying all ANSI/EIA/TIA 568C.2 specifications or Category 6 as applicable. Performance requirements for testers will meet the Level II-E accuracy. The contractor shall provide proof of current factory calibration of all test equipment. Tests shall be in accordance with TSB-67 Level II-E accuracy. Test and certify all station cable for all ANSI/EIA/TIA 568C.2 Additional Transmission Performance Guidelines. Provide test reports in electronic flat ASCII file format. Installations by outside contractor shall be certified and warranted by the manufacturer for operation at current ANSI/EIA/TIA 568C.l 250 MHz for a period of not less than 20 years.
    3. Optical test equipment shall be suitable for measuring the attenuation and optical characteristics of the installed fiber optic plant. Provide records of recent factory calibration of all test equipment. The following fiber optic testing standards shall apply:
        i. TIA 526-7 (OFSTP-7) Measurement of Optical Loss of Singlemode Fiber Optic Cable Plant.
        ii. TIA 526-14-A (OFSTP-14) Measurement of Optical Loss of Multimode Fiber Optic Cable Plant.
        iii. Pre-installation Testing: Both factory and onsite on-reel certification shall be performed on the cable prior to installation. Test records will be made available to CCSD upon request.
        iv. Post-Installation Testing: Two optical tests shall be performed, Optical Time Domain Reflectometer (OTDR) test and attenuation (power meter) test per the following standards:
            (1) TIA 526-7 (OFSTP-7) Measurement of Optical Loss of Singlemode Fiber Optic Cable Plant
            (2) TIA 526-14-A (OFSTP-14) Measurement of Optical Loss of Multimode Fiber Optic Cable Plant
        v. The OTDR test shall be used to determine the adequacy of the cable installations. The OTDR test shall be measured in both directions. A reference length of fiber, 328 feet minimum, used as the delay line shall be placed before the new connector and after the far end patch panel connectors for inspection of connector signature.
        vi. End-to-end attenuation measurements shall be made on all fiber optic cables, in both directions, using the appropriate light source for the window in test.
    4. The Contractor shall provide test reports, in electronic flat ASCII file format (Microsoft Excel compatible) to the Owner and Technology Consultant. Additionally, the Contractor shall provide one (1) licensed copy of test equipment software that provides a means for viewing both copper and fiber test results in the format matching that of the original test equipment.

h. Fire stopping
    1. The design team is responsible for specifying the fire stopping requirements and the contractor is responsible for installing fire stopping where required by code and using only systems that are code compliant. Fire stop systems shall comply with the system manufacturer's written installation instructions and published drawings for products and applications indicated.

i. Bonding and grounding
    1. The design team shall be responsible for specifying all bonding and grounding requirements supporting the structured cabling system. Grounding must be in accordance with the NEC, NFPA and all local codes and ANSI/EIA/TIA standards. The design shall include approved ground at all newly installed distribution frames, and/or insuring proper bonding to any existing facilities. In addition, the cabling contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and framework. All grounds shall consist of a minimum of a #6 AWG copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground.

j. Labeling
    1. The design team responsible for communicating the following cable labeling requirements in the construction documents.
    2. All labels shall be printed for all cables, distribution frames, and outlet locations, according to labeling scheme listed below. Labeling shall be in accordance with the recommendations found in TIA/EIA 606A, the manufacturer’s recommendations/installation guides, and industry best practices. All switches, connectors, outlets, etc., shall be clearly logically, and permanently labeled during installation. Label all cables both at the receptacle and equipment rack with vinyl wire markers. Although the below labeling scheme is provided, it is a guideline and should be confirmed with CCSD IST during design and again at the beginning of installation.
        i. Level 1 – Building level where the telecom room is located
        ii. Level 2 – Telecom room number
        iii. Level 3 – Patch panel by letter
        iv. Level 4 – Port number on the patch panel
        v. Example: A cable terminated in a telecom room located on the second floor in telecom room 202B on port number 23 of panel C would be labeled 2-202B-C-23

k. Refer to responsibility matrix below

MATRIX OF CONSTRUCTION RESPONSIBILITIES

THE RESPONSIBILITIES LISTED HEREIN ARE PROVIDED AS A RECOMMENDATION AND DO NOT SUPERSEDE OR REPLACE ANY CONTRACTS, OR OTHERWISE DEFINED RESPONSIBILITIES, BETWEEN THE DESIGNATED PARTIES. IN ADDITION, THE INFORMATION IS MEANT TO INDICATE GENERAL RESPONSIBILITY FOR A SCOPE OF WORK AND IN NO WAY DISALLOWS THE RESPONSIBLE PARTY TO SUBCONTRACT THE SCOPE.

RESPONSIBLE PARTY	GENERAL CONTRACTOR		ELECTRICAL CONTRACTOR		TELECOM CONTRACTOR		LOW VOLTAGE CONTRACTOR		AUDIO-VIDEO CONTRACTOR		SECURITY CONTRACTOR		OWNER		NOTES
SCOPE OF WORK	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	
BUDGET OF WORK	CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		FIX-FURN-EQUIP		
SITE															
INCOMING SERVICE PROVIDER CABLING & COORDINATION													X	X	1
EXTERIOR CONDUIT PATHWAY / DUCTBANK			X	X											
INTERIOR INFRASTRUCTURE															
GROUNDING & BONDING			X	X	X	X									3, 4
INTERIOR CONDUIT PATHWAY			X	X											
BACKBOX / JUNCTION BOX			X	X											
FLOOR BOX / POKE THROUGH			X	X		X									5
CABLE TRAY			X	X											
J-HOOK / SLING					X	X									
SLEEVE / CONDUIT PENETRATIONS			X	X	X	X									6, 7
TELECOMMUNICATIONS															
PLYWOOD BACKBOARD	X	X													
LADDER RACK / LADDER RUNWAY / ACCESSORIES					X	X									
RACK / FRAME / CABINET (TELECOM)					X	X									
WIREMANAGER					X	X									
FIBER PATCH PANEL					X	X									
COPPER PATCH PANEL					X	X									
POWER DISTRIBUTION UNIT (PDU)					X	X									
UNINTERRUPTIBLE POWER SUPLY (UPS)					X	X									
MISCELLANEOUS RACK COMPONENTS (DRAWER, SHELF, ETC.)					X	X									
BACKBONE CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
HORIZONTAL CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
FACEPLATE / JACK / SURFACE MOUNT BOX					X	X									
PATCH CABLE (INTERIOR TO TELECOMMUNICATIONS ROOM)					X									X	
PATCH CABLE (END DEVICE / OUTLET)					X	X		X		X		X		X	2
LABELING					X	X									
MEDIA CONVERTERS / COPPER EXTENDERS FOR NETWORK CABLING					X	X									
WIRELESS ACCESS POINT (WAP)						X							X		
BUILDING NETWORK (LAN) EQUIPMENT (SWITCH, HEADEND, ETC.)													X	X	9
PERIPHERAL EQUIPMENT (PHONE, PRINTER, PC, ETC.)													X	X	
LOW VOLTAGE (LV)															
PAGING / PUBLIC ADDRESS							X	X							
CELLULAR DISTRIBUTED ANTENNA SYSTEM (DAS)	X	X													
BUILDING NETWORK (LAN) CABLING TO LV SYSTEM(S)					X	X									
AUDIO VISUAL (AV)															
RACK / FRAME / CABINET (AV)									X	X					
AMPLIFIER / CONTROLLER / PROCESSOR / MATRIX									X	X					
MICROPHONE									X	X					
FACEPLATE / JACK									X	X					
CABLING (NON-NETWORK)									X	X					
SPEAKER									X	X					
DISPLAY & MOUNT									X	X					
DISPLAY BACKING	X	X													
PROJECTOR									X	X					
PROJECTOR SCREEN									X	X					
AUDIO VIDEO NETWORK EQUIPMENT (SWITCHES AND CABLING)									X	X					9
BUILDING NETWORK (LAN) CABLING TO AUDIO VIDEO SYSTEM(S)					X	X									9
SECURITY - ACCESS CONTROL SYSTEM (ACS)															
ACS HEADEND / CONTROLLER / PANEL											X	X			
ACS SOFTWARE, PROGRAMMING, & INTEGRATION											X	X	X	X	
CARD READER / KEYPAD AND LICENSE (AUTHENTICATION DEVICE)											X	X			
REQUEST TO EXIT (WHEN NOT INTEGRAL TO DOOR HARDWARE)											X	X			
INTERCOM & INTERCOM MASTER STATION											X	X			
DOOR POSITION SWITCH											X	X			
DOOR RELEASE BUTTON											X	X			
DOOR HARDWARE / COMPONENTS	X	X													
BUILDING NETWORK (LAN) CABLING TO ACS					X	X									9
SECURITY - VIDEO SURVIELLANCE SYSTEM (VSS)															
VSS NETWORK VIDEO RECORDER (NVR)													X	X	
VSS SOFTWARE, PROGRAMMING, & INTEGRATION													X	X	
CAMERA AND LICENSE											X	X			
BUILDING NETWORK (LAN) CABLING TO VSS					X	X									9
SECURITY - INTRUSION DETECTION SYSTEM (IDS)															
ID HEADEND / CONTROLLER / PANEL											X	X			
ID SOFTWARE, PROGRAMMING, & INTEGRATION											X	X			
MOTION SENSOR &/OR GLASS BREAK SENSORS											X	X			
LOCK-DOWN BUTTON											X	X			
PANIC / DURESS BUTTON											X	X			
AUTO-DIALER & DIAL DESTINATION COORDINATION											X	X			
BUILDING NETWORK (LAN) CABLING TO IDS					X	X									9

NOTES:

1. CONTRACTOR SHALL COORDINATE WITH OWNER REGARDING TIMELINE OF INSTALLATION AND REQUIREMENTS FOR INSTALLATION TO ENSURE A TIMLEY INSTALLATION.
2. THE PARTY RESPONSIBLE FOR INSTALLING THE END DEVICE (PC, CAMERA, WAP, ETC.) SHALL BE RESPONSIBLE FOR INSTALLING THE END-OF-RUN PATCH CABLE. AFTER INSTALLATION, VERIFICATION OF OPERABILITY IS REQUIRED.
3. THE ELECTRICAL CONTRACTOR SHALL i) EXTEND THE BUILDING GROUND TO EACH TELECOMMUNICATION SPACE ii) PROVIDE AND INSTALL THE BUSBAR(S), GROUNDING CABLES, AND ASSOCIATED EQUIPMENT, iii) AND ENSURE EACH TELECOMMUNICATION SPACE HAS PROPER ACCESS TO BUILDING GROUND THROUGH THE LOCAL BUSBAR AS SHOWN IN THE DRAWINGS.
4. FOR ALL DEVICES, EQUIPMENT, PATHWAY, AND OTHER SUCH MATERIAL REQUIRED TO BE GROUNDED, THE CONTRACTOR/PARTY, WITH WHICH THE DEVICE, EQUIPMENT, PATHWAY OR OTHER SUCH MATERIAL WAS INSTALLED BY, SHALL BE RESPONSIBLE FOR ITS PROPER BONDING AND GROUNDING.
5. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION AND INSTALLATION OF ALL FLOOR BOXES AND POKE THROUGHS, AS WELL AS ALL CONDUIT/PATHWAY REQUIREMENTS PERTAINING TO IT, REGARDLESS IF THERE IS POWER CABLING INCLUDED AT DEVICE. THE TELECOM CONTRACTOR SHALL COORDINATE WITH DRAWINGS AND ELECTRICAL CONTRACTOR TO ENSURE LOW VOLTAGE INFRASTRUCTURE AND CABLING REQUIREMENTS ARE MET AND SHALL PROVIDE AND INSTALL ALL CABLING AND FACEPLATE/TERMINATION EQUIPMENT PERTAINING TO DEVICE.
6. FOR ALL PENETRATIONS SHOWN IN DRAWINGS, THE ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL. THE ELECTRICAL CONTRACTOR SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE.
7. ALL PENETRATIONS NOT SHOWN ON DRAWINGS, BUT REQUIRED FOR CABLING INSTALLATION, SHALL BE PROVIDED AND INSTALLED BY THE CABLING INSTALLATION CONTRACTOR/TEAM. FOR FIRE-RATED PENETRATIONS, THE CABLE INSTALLATION CONTRACTOR/TEAM SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE. AFTER ALL CABLING IS INSTALLED, TESTED, AND ACCEPTED, THE INTERIOR OF EACH PENETRATION SHALL BE FIRE-RATED TO MATCH OR EXCEED THE PENETRATED MATERIAL.
8. IT IS ACCEPTABLE FOR THE CONTRACTOR TO REUSE AN EXISTING DEVICE WITH OWNER APPROVAL. COORDINATE WITH OWNER PRIOR TO ANY NEW DEVICE PROCUREMENT TO RECORD ALL DEVICES THAT MAY BE REUSED. FOR ALL DEVICES SCHEDULED FOR REUSE THAT REPLACE AN ITEM SCHEDULED FOR NEW, A CREDIT SHALL BE GIVEN TO OWNER FOR ITEM REPLACEMENT.
9. THE BUILDING NETWORK IS THE LOCAL AREA NETWORK (LAN) OF THE BUILDING AND CONNECTS DIRECTLY TO THE INCOMING SERVICE PROVIDER; IT PROVIDES GENERAL ACCESS TO THE WIDE AREA NETWORK (WAN). OTHER SYSTEMS MAY UTILIZE NETWORK EQUIPMENT TO SUPPORT THEIR SPECIFIC NEEDS, HOWEVER, THIS EQUIPMENT IS SEPARATE AND DISTINCT FROM THE BUILDING NETWORK (LAN) AND ASSOCIATED

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SECTION 27 41 16

INTEGRATED AUDIO VIDEO SYSTEM

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. PURPOSE
   1. The purpose of this document is to provide design guidelines for architects, engineers, consultants, and contractors with an understanding of the minimum requirements for Telecommunications Infrastructure and other Technology systems for any building related project within the Cherry Creek School District (CCSD). If the building is existing, the requirements outlined below should be met to best of the ability of the design team and/or contractor. If the building is new construction, the requirements outlined below must be adhered to unless written approval is provided from CCSD IST prior to design completion.

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. SUMMARY – SECTION INCLUDES
   1. Integrated Audio Video System

E. INTEGRATED AUDIO VIDEO SYSTEM
   1. Requirements for integrated audio video system
      a. Submittal
      b. Classroom audio video shall follow current structured cabling section 27 10 00. Current standard is to install an HDMI connection to a ceiling mounted district standard projector. Unless otherwise specified, the jack shall be located in the center of the presentation wall below the whiteboard.
      c. Non-classroom systems are left to the individual school to purchase. It shall be the responsibility of the contractor to install all the infrastructure to support the audio video systems. Infrastructure requirements shall be coordinated with CCSD IST during the design phase process.

d. Refer to responsibility matrix below

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RESPONSIBLE PARTY	GENERAL CONTRACTOR		ELECTRICAL CONTRACTOR		TELECOM CONTRACTOR		LOW VOLTAGE CONTRACTOR		AUDIO-VIDEO CONTRACTOR		SECURITY CONTRACTOR		OWNER		NOTES
SCOPE OF WORK	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	
BUDGET OF WORK	CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		FIX-FURN-EQUIP		
SITE															
INCOMING SERVICE PROVIDER CABLING & COORDINATION													X	X	1
EXTERIOR CONDUIT PATHWAY / DUCTBANK			X	X											
INTERIOR INFRASTRUCTURE															
GROUNDING & BONDING			X	X	X	X									3, 4
INTERIOR CONDUIT PATHWAY			X	X											
BACKBOX / JUNCTION BOX			X	X											
FLOOR BOX / POKE THROUGH			X	X		X									5
CABLE TRAY			X	X											
J-HOOK / SLING					X	X									
SLEEVE / CONDUIT PENETRATIONS			X	X	X	X									6, 7
TELECOMMUNICATIONS															
PLYWOOD BACKBOARD	X	X													
LADDER RACK / LADDER RUNWAY / ACCESSORIES					X	X									
RACK / FRAME / CABINET (TELECOM)					X	X									
WIREMANAGER					X	X									
FIBER PATCH PANEL					X	X									
COPPER PATCH PANEL					X	X									
POWER DISTRIBUTION UNIT (PDU)					X	X									
UNINTERRUPTIBLE POWER SUPLY (UPS)					X	X									
MISCELLANEOUS RACK COMPONENTS (DRAWER, SHELF, ETC.)					X	X									
BACKBONE CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
HORIZONTAL CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
FACEPLATE / JACK / SURFACE MOUNT BOX					X	X									
PATCH CABLE (INTERIOR TO TELECOMMUNICATIONS ROOM)					X									X	
PATCH CABLE (END DEVICE / OUTLET)					X	X		X		X		X		X	2
LABELING					X	X									
MEDIA CONVERTERS / COPPER EXTENDERS FOR NETWORK CABLING					X	X									
WIRELESS ACCESS POINT (WAP)						X							X		
BUILDING NETWORK (LAN) EQUIPMENT (SWITCH, HEADEND, ETC.)													X	X	9
PERIPHERAL EQUIPMENT (PHONE, PRINTER, PC, ETC.)													X	X	
LOW VOLTAGE (LV)															
PAGING / PUBLIC ADDRESS							X	X							
CELLULAR DISTRIBUTED ANTENNA SYSTEM (DAS)	X	X													
BUILDING NETWORK (LAN) CABLING TO LV SYSTEM(S)					X	X									
AUDIO VISUAL (AV)															
RACK / FRAME / CABINET (AV)									X	X					
AMPLIFIER / CONTROLLER / PROCESSOR / MATRIX									X	X					
MICROPHONE									X	X					
FACEPLATE / JACK									X	X					
CABLING (NON-NETWORK)									X	X					
SPEAKER									X	X					
DISPLAY & MOUNT									X	X					
DISPLAY BACKING	X	X													
PROJECTOR									X	X					
PROJECTOR SCREEN									X	X					
AUDIO VIDEO NETWORK EQUIPMENT (SWITCHES AND CABLING)									X	X					9
BUILDING NETWORK (LAN) CABLING TO AUDIO VIDEO SYSTEM(S)					X	X									9
SECURITY - ACCESS CONTROL SYSTEM (ACS)															
ACS HEADEND / CONTROLLER / PANEL											X	X			
ACS SOFTWARE, PROGRAMMING, & INTEGRATION											X	X	X	X	
CARD READER / KEYPAD AND LICENSE (AUTHENTICATION DEVICE)											X	X			
REQUEST TO EXIT (WHEN NOT INTEGRAL TO DOOR HARDWARE)											X	X			
INTERCOM & INTERCOM MASTER STATION											X	X			
DOOR POSITION SWITCH											X	X			
DOOR RELEASE BUTTON											X	X			
DOOR HARDWARE / COMPONENTS	X	X													
BUILDING NETWORK (LAN) CABLING TO ACS					X	X									9
SECURITY - VIDEO SURVIELLANCE SYSTEM (VSS)															
VSS NETWORK VIDEO RECORDER (NVR)													X	X	
VSS SOFTWARE, PROGRAMMING, & INTEGRATION													X	X	
CAMERA AND LICENSE											X	X			
BUILDING NETWORK (LAN) CABLING TO VSS					X	X									9
SECURITY - INTRUSION DETECTION SYSTEM (IDS)															
ID HEADEND / CONTROLLER / PANEL											X	X			
ID SOFTWARE, PROGRAMMING, & INTEGRATION											X	X			
MOTION SENSOR &/OR GLASS BREAK SENSORS											X	X			
LOCK-DOWN BUTTON											X	X			
PANIC / DURESS BUTTON											X	X			
AUTO-DIALER & DIAL DESTINATION COORDINATION											X	X			
BUILDING NETWORK (LAN) CABLING TO IDS					X	X									9

NOTES:

1. CONTRACTOR SHALL COORDINATE WITH OWNER REGARDING TIMELINE OF INSTALLATION AND REQUIREMENTS FOR INSTALLATION TO ENSURE A TIMLEY INSTALLATION.
2. THE PARTY RESPONSIBLE FOR INSTALLING THE END DEVICE (PC, CAMERA, WAP, ETC.) SHALL BE RESPONSIBLE FOR INSTALLING THE END-OF-RUN PATCH CABLE. AFTER INSTALLATION, VERIFICATION OF OPERABILITY IS REQUIRED.
3. THE ELECTRICAL CONTRACTOR SHALL i) EXTEND THE BUILDING GROUND TO EACH TELECOMMUNICATION SPACE ii) PROVIDE AND INSTALL THE BUSBAR(S), GROUNDING CABLES, AND ASSOCIATED EQUIPMENT, iii) AND ENSURE EACH TELECOMMUNICATION SPACE HAS PROPER ACCESS TO BUILDING GROUND THROUGH THE LOCAL BUSBAR AS SHOWN IN THE DRAWINGS.
4. FOR ALL DEVICES, EQUIPMENT, PATHWAY, AND OTHER SUCH MATERIAL REQUIRED TO BE GROUNDED, THE CONTRACTOR/PARTY, WITH WHICH THE DEVICE, EQUIPMENT, PATHWAY OR OTHER SUCH MATERIAL WAS INSTALLED BY, SHALL BE RESPONSIBLE FOR ITS PROPER BONDING AND GROUNDING.
5. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION AND INSTALLATION OF ALL FLOOR BOXES AND POKE THROUGHS, AS WELL AS ALL CONDUIT/PATHWAY REQUIREMENTS PERTAINING TO IT, REGARDLESS IF THERE IS POWER CABLING INCLUDED AT DEVICE. THE TELECOM CONTRACTOR SHALL COORDINATE WITH DRAWINGS AND ELECTRICAL CONTRACTOR TO ENSURE LOW VOLTAGE INFRASTRUCTURE AND CABLING REQUIREMENTS ARE MET AND SHALL PROVIDE AND INSTALL ALL CABLING AND FACEPLATE/TERMINATION EQUIPMENT PERTAINING TO DEVICE.
6. FOR ALL PENETRATIONS SHOWN IN DRAWINGS, THE ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL. THE ELECTRICAL CONTRACTOR SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE.
7. ALL PENETRATIONS NOT SHOWN ON DRAWINGS, BUT REQUIRED FOR CABLING INSTALLATION, SHALL BE PROVIDED AND INSTALLED BY THE CABLING INSTALLATION CONTRACTOR/TEAM. FOR FIRE-RATED PENETRATIONS, THE CABLE INSTALLATION CONTRACTOR/TEAM SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE. AFTER ALL CABLING IS INSTALLED, TESTED, AND ACCEPTED, THE INTERIOR OF EACH PENETRATION SHALL BE FIRE-RATED TO MATCH OR EXCEED THE PENETRATED MATERIAL.
8. IT IS ACCEPTABLE FOR THE CONTRACTOR TO REUSE AN EXISTING DEVICE WITH OWNER APPROVAL. COORDINATE WITH OWNER PRIOR TO ANY NEW DEVICE PROCUREMENT TO RECORD ALL DEVICES THAT MAY BE REUSED. FOR ALL DEVICES SCHEDULED FOR REUSE THAT REPLACE AN ITEM SCHEDULED FOR NEW, A CREDIT SHALL BE GIVEN TO OWNER FOR ITEM REPLACEMENT.
9. THE BUILDING NETWORK IS THE LOCAL AREA NETWORK (LAN) OF THE BUILDING AND CONNECTS DIRECTLY TO THE INCOMING SERVICE PROVIDER; IT PROVIDES GENERAL ACCESS TO THE WIDE AREA NETWORK (WAN). OTHER SYSTEMS MAY UTILIZE NETWORK EQUIPMENT TO SUPPORT THEIR SPECIFIC NEEDS, HOWEVER, THIS EQUIPMENT IS SEPARATE AND DISTINCT FROM THE BUILDING NETWORK (LAN) AND ASSOCIATED

END OF SECTION

SECTION 27 51 13

OVERHEAD PAGING SYSTEM

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. PURPOSE
   1. The purpose of this document is to provide design guidelines for architects, engineers, consultants, and contractors with an understanding of the minimum requirements for Telecommunications Infrastructure and other Technology systems for any building related project within the Cherry Creek School District (CCSD). If the building is existing, the requirements outlined below should be met to best of the ability of the design team and/or contractor. If the building is new construction, the requirements outlined below must be adhered to unless written approval is provided from CCSD IST prior to design completion.

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. SUMMARY – SECTION INCLUDES
   1. Overhead Paging System

E. OVERHEAD PAGING SYSTEM
   1. Requirements for overhead paging system
      a. Submittal
      b. Generally: Overhead paging system shall follow current structured cabling section 27 10 00. Cherry Creek School District (CCSD) requires a Valcom IP based intercom system. A Valcom (8022) to be utilized for the District's Cisco phones to access the intercom system. A Valcom (8048) required for security integration.
      c. Individual communication to each teaching space including a call button, IP compact speaker with text/flasher (VL520BK-F-IC) connect the space to the building administration, and Security Offices. Teaching spaces are defined as any space in which students and teachers conduct classes. These areas include all classrooms, intervention rooms, gymnasiums and commons areas where classes can be conducted.

d. All corridors, multi-occupancy toilet rooms, faculty offices, work rooms, and common areas have analog and zoned accordingly with Valcom (8004) or equivalent devices with the exception of multi-occupancy office spaces, conference rooms and Principal's Office that will utilize a (VL520BK-F-IC). The (VL550F) 40 inch PoE boards will be utilized in large areas such as the gymnasiums and cafeterias for legible messaging. Adequate exterior coverage using one way horns shall be installed around the perimeter of the building.
e. Exterior horns zoned by north, south, east and west coverage areas.
f. All conference rooms and the Main Office have an IP speaker.
g. Separate zones to provide analog speakers in gyms, cafeteria, north/south commons and library. A means to shunt fixed in place sound systems in areas such as gyms and commons areas shall be provided.
h. An all-call desktop microphone and remote input module (V-9130) via (V-8002) will in the Main Offices.
i. Elementary schools and Administrative buildings: one (1) administrative phone in the Main Office.
j. Middle schools: two (2) administrative phones; one (1) in the Main Office, and one (1) in the Security Office.
k. High schools: three (3) administrative phones; one (1) in the Main Office, one (1) in an administrative office as directed, and one (1) in the Security Office.
l. One (1) 40 inch PoE admin sign (VL550F) to be utilized in Main Office for room call-in information.
m. Document on building floor plans.
i. Panic/lockdown buttons report through the overhead paging system.
n. Minimum capabilities and components as follows:
    1. Multiple event schedules for bells or other messaging
    2. The ability to use sound files for bells or prerecorded messages
    3. Multiple options for paging zones including, but not limited to, all zones, inside/outside, assembly areas, etc.
    4. The ability to display messages via PoE message boards
    5. Server allowing for 10 percent future expansion end points SIP compliant dual enhanced network audio port for music and microphone
    6. SIP compliant dual enhanced network audio port (for analog circuits)
    7. Dual enhanced network trunk (FXO) port
    8. Networked input and relay module (VE8048A/VE8048AR) required for security integration
    9. FXS dual network station port
    10. Main Office: one (1) IP speaker with text/flasher (VL550BK-F), one (1) all call desktop microphone and remote input module, one (1) administrative phone
    11. Teaching Spaces: one (1) IP compact speaker with text/flasher (VL520BK-F), one (1) call in button (V-2972), and additional speaker in rooms larger than 800 square feet
    12. Gymnasiums: one (1) IP speaker with text/flasher (VL550BK-F), one (1) call in button (V-2972), and additional separately zoned analog speakers to achieve intelligibility
    13. Cafeterias: One (1) for Elementary schools, two (2) for Middle and High schools speaker with text/flasher (VL550BK-F IP), and additional separately zoned analog speakers to achieve intelligibility
    14. Single Occupancy Faculty Office: one (1) analog 1-way speaker (VE9022A-2 for lay-in ceilings and V1920C or V1020C for drywall ceilings)
    15. Multi-occupancy Office: one (1) IP compact speaker with text/flasher (VL520BK-F)

16. Corridors, or multi-occupancy toilet rooms, or mechanical rooms: Analog 1-way speakers (VE9022A-2 for lay-in ceilings and V1920C or V1020C for drywall ceilings) located no more than 30 feet on center in any direction
17. Single occupancy toilet rooms and storage rooms: no devices
18. Conference rooms: one (1) IP lay-in IP speaker (VE4022)
19. Security Office (Middle schools): one (1) IP compact speaker with text/flasher (VL520BK-F) and one (1) administrative phone
20. Principle Office: one (1) IP compact speaker with text/flasher (VL520BK-F)
21. Exterior: Analog 1-way flex horns (V9880) quantity to achieve full intelligibility on all playgrounds and parking lots with separate zones for north, south, east, and west areas

o. Refer to responsibility matrix below

MATRIX OF CONSTRUCTION RESPONSIBILITIES

THE RESPONSIBILITIES LISTED HEREIN ARE PROVIDED AS A RECOMMENDATION AND DO NOT SUPERSEDE OR REPLACE ANY CONTRACTS, OR OTHERWISE DEFINED RESPONSIBILITIES, BETWEEN THE DESIGNATED PARTIES. IN ADDITION, THE INFORMATION IS MEANT TO INDICATE GENERAL RESPONSIBILITY FOR A SCOPE OF WORK AND IN NO WAY DISALLOWS THE RESPONSIBLE PARTY TO SUBCONTRACT THE SCOPE.

RESPONSIBLE PARTY	GENERAL CONTRACTOR		ELECTRICAL CONTRACTOR		TELECOM CONTRACTOR		LOW VOLTAGE CONTRACTOR		AUDIO-VIDEO CONTRACTOR		SECURITY CONTRACTOR		OWNER		NOTES
SCOPE OF WORK	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	
BUDGET OF WORK	CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		FIX-FURN-EQUIP		
SITE															
INCOMING SERVICE PROVIDER CABLING & COORDINATION													X	X	1
EXTERIOR CONDUIT PATHWAY / DUCTBANK			X	X											
INTERIOR INFRASTRUCTURE															
GROUNDING & BONDING			X	X	X	X									3, 4
INTERIOR CONDUIT PATHWAY			X	X											
BACKBOX / JUNCTION BOX			X	X											
FLOOR BOX / POKE THROUGH			X	X		X									5
CABLE TRAY			X	X											
J-HOOK / SLING					X	X									
SLEEVE / CONDUIT PENETRATIONS			X	X	X	X									6, 7
TELECOMMUNICATIONS															
PLYWOOD BACKBOARD	X	X													
LADDER RACK / LADDER RUNWAY / ACCESSORIES					X	X									
RACK / FRAME / CABINET (TELECOM)					X	X									
WIREMANAGER					X	X									
FIBER PATCH PANEL					X	X									
COPPER PATCH PANEL					X	X									
POWER DISTRIBUTION UNIT (PDU)					X	X									
UNINTERRUPTIBLE POWER SUPLY (UPS)					X	X									
MISCELLANEOUS RACK COMPONENTS (DRAWER, SHELF, ETC.)					X	X									
BACKBONE CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
HORIZONTAL CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
FACEPLATE / JACK / SURFACE MOUNT BOX					X	X									
PATCH CABLE (INTERIOR TO TELECOMMUNICATIONS ROOM)					X									X	
PATCH CABLE (END DEVICE / OUTLET)					X	X		X		X		X		X	2
LABELING					X	X									
MEDIA CONVERTERS / COPPER EXTENDERS FOR NETWORK CABLING					X	X									
WIRELESS ACCESS POINT (WAP)						X							X		
BUILDING NETWORK (LAN) EQUIPMENT (SWITCH, HEADEND, ETC.)													X	X	9
PERIPHERAL EQUIPMENT (PHONE, PRINTER, PC, ETC.)													X	X	
LOW VOLTAGE (LV)															
PAGING / PUBLIC ADDRESS							X	X							
CELLULAR DISTRIBUTED ANTENNA SYSTEM (DAS)	X	X													
BUILDING NETWORK (LAN) CABLING TO LV SYSTEM(S)					X	X									
AUDIO VISUAL (AV)															
RACK / FRAME / CABINET (AV)									X	X					
AMPLIFIER / CONTROLLER / PROCESSOR / MATRIX									X	X					
MICROPHONE									X	X					
FACEPLATE / JACK									X	X					
CABLING (NON-NETWORK)									X	X					
SPEAKER									X	X					
DISPLAY & MOUNT									X	X					
DISPLAY BACKING	X	X													
PROJECTOR									X	X					
PROJECTOR SCREEN									X	X					
AUDIO VIDEO NETWORK EQUIPMENT (SWITCHES AND CABLING)									X	X					9
BUILDING NETWORK (LAN) CABLING TO AUDIO VIDEO SYSTEM(S)					X	X									9
SECURITY - ACCESS CONTROL SYSTEM (ACS)															
ACS HEADEND / CONTROLLER / PANEL											X	X			
ACS SOFTWARE, PROGRAMMING, & INTEGRATION											X	X	X	X	
CARD READER / KEYPAD AND LICENSE (AUTHENTICATION DEVICE)											X	X			
REQUEST TO EXIT (WHEN NOT INTEGRAL TO DOOR HARDWARE)											X	X			
INTERCOM & INTERCOM MASTER STATION											X	X			
DOOR POSITION SWITCH											X	X			
DOOR RELEASE BUTTON											X	X			
DOOR HARDWARE / COMPONENTS	X	X													
BUILDING NETWORK (LAN) CABLING TO ACS					X	X									9
SECURITY - VIDEO SURVIELLANCE SYSTEM (VSS)															
VSS NETWORK VIDEO RECORDER (NVR)													X	X	
VSS SOFTWARE, PROGRAMMING, & INTEGRATION													X	X	
CAMERA AND LICENSE											X	X			
BUILDING NETWORK (LAN) CABLING TO VSS					X	X									9
SECURITY - INTRUSION DETECTION SYSTEM (IDS)															
ID HEADEND / CONTROLLER / PANEL											X	X			
ID SOFTWARE, PROGRAMMING, & INTEGRATION											X	X			
MOTION SENSOR &/OR GLASS BREAK SENSORS											X	X			
LOCK-DOWN BUTTON											X	X			
PANIC / DURESS BUTTON											X	X			
AUTO-DIALER & DIAL DESTINATION COORDINATION											X	X			
BUILDING NETWORK (LAN) CABLING TO IDS					X	X									9

NOTES:

1. CONTRACTOR SHALL COORDINATE WITH OWNER REGARDING TIMELINE OF INSTALLATION AND REQUIREMENTS FOR INSTALLATION TO ENSURE A TIMLEY INSTALLATION.
2. THE PARTY RESPONSIBLE FOR INSTALLING THE END DEVICE (PC, CAMERA, WAP, ETC.) SHALL BE RESPONSIBLE FOR INSTALLING THE END-OF-RUN PATCH CABLE. AFTER INSTALLATION, VERIFICATION OF OPERABILITY IS REQUIRED.
3. THE ELECTRICAL CONTRACTOR SHALL i) EXTEND THE BUILDING GROUND TO EACH TELECOMMUNICATION SPACE ii) PROVIDE AND INSTALL THE BUSBAR(S), GROUNDING CABLES, AND ASSOCIATED EQUIPMENT, iii) AND ENSURE EACH TELECOMMUNICATION SPACE HAS PROPER ACCESS TO BUILDING GROUND THROUGH THE LOCAL BUSBAR AS SHOWN IN THE DRAWINGS.
4. FOR ALL DEVICES, EQUIPMENT, PATHWAY, AND OTHER SUCH MATERIAL REQUIRED TO BE GROUNDED, THE CONTRACTOR/PARTY, WITH WHICH THE DEVICE, EQUIPMENT, PATHWAY OR OTHER SUCH MATERIAL WAS INSTALLED BY, SHALL BE RESPONSIBLE FOR ITS PROPER BONDING AND GROUNDING.
5. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION AND INSTALLATION OF ALL FLOOR BOXES AND POKE THROUGHS, AS WELL AS ALL CONDUIT/PATHWAY REQUIREMENTS PERTAINING TO IT, REGARDLESS IF THERE IS POWER CABLING INCLUDED AT DEVICE. THE TELECOM CONTRACTOR SHALL COORDINATE WITH DRAWINGS AND ELECTRICAL CONTRACTOR TO ENSURE LOW VOLTAGE INFRASTRUCTURE AND CABLING REQUIREMENTS ARE MET AND SHALL PROVIDE AND INSTALL ALL CABLING AND FACEPLATE/TERMINATION EQUIPMENT PERTAINING TO DEVICE.
6. FOR ALL PENETRATIONS SHOWN IN DRAWINGS, THE ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL. THE ELECTRICAL CONTRACTOR SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE.
7. ALL PENETRATIONS NOT SHOWN ON DRAWINGS, BUT REQUIRED FOR CABLING INSTALLATION, SHALL BE PROVIDED AND INSTALLED BY THE CABLING INSTALLATION CONTRACTOR/TEAM. FOR FIRE-RATED PENETRATIONS, THE CABLE INSTALLATION CONTRACTOR/TEAM SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE. AFTER ALL CABLING IS INSTALLED, TESTED, AND ACCEPTED, THE INTERIOR OF EACH PENETRATION SHALL BE FIRE-RATED TO MATCH OR EXCEED THE PENETRATED MATERIAL.
8. IT IS ACCEPTABLE FOR THE CONTRACTOR TO REUSE AN EXISTING DEVICE WITH OWNER APPROVAL. COORDINATE WITH OWNER PRIOR TO ANY NEW DEVICE PROCUREMENT TO RECORD ALL DEVICES THAT MAY BE REUSED. FOR ALL DEVICES SCHEDULED FOR REUSE THAT REPLACE AN ITEM SCHEDULED FOR NEW, A CREDIT SHALL BE GIVEN TO OWNER FOR ITEM REPLACEMENT.
9. THE BUILDING NETWORK IS THE LOCAL AREA NETWORK (LAN) OF THE BUILDING AND CONNECTS DIRECTLY TO THE INCOMING SERVICE PROVIDER; IT PROVIDES GENERAL ACCESS TO THE WIDE AREA NETWORK (WAN). OTHER SYSTEMS MAY UTILIZE NETWORK EQUIPMENT TO SUPPORT THEIR SPECIFIC NEEDS, HOWEVER, THIS EQUIPMENT IS SEPARATE AND DISTINCT FROM THE BUILDING NETWORK (LAN) AND ASSOCIATED

END OF SECTION

SECTION 27 51 23

EDUCATIONAL COMMUNICATION SYSTEM

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. SUMMARY – SECTION INCLUDES
   1. Educational Intercommunications System, Classroom Sound Enhancement System, Elementary School Gymnasium Rack Sound System, Middle School Cafetorium Rack Sound System, Middle School Gymnasium Rack Sound System, High School Gymnasium Rack Sound System, and High School Auditorium Rack Sound System

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. EDUCATIONAL INTERCOMMUNICATIONS SYSTEM

   1. Requirements for educational intercommunications system refer to section 27 51 13

E. CLASSROOM SOUND ENHANCEMENT SYSTEM
   1. Requirements for classroom sound enhancement system (need to review with CCSD staff on the particular project)
      a. Submittal
      b. Classroom sound enhancement system shall follow current structured cabling section 27 10 00
      c. Manufactured by Atlas Learn or Lightspeed (no equivalent)
      d. Ceiling mounted dome sensor
      e. Ceiling mounted speakers
      f. Two (2) lanyard wireless full sized microphones with one (1) charging/docking station
      g. Amplifier/receiver with two microphone, computer, TV/VCR, CD/DVD, and auxiliary inputs
      h. Locate in all instructional spaces
      i. Amplifier and microphone charging/docking station cabinet mounted with duplex receptacle
      j. One speaker per 200 square feet (or fraction thereof) of instructional spaces

F. ELEMENTARY SCHOOL GYMNASIUM RACK SOUND SYSTEM

1. Requirements for elementary school gymnasium rack sound system (because of the constant product changes and approach, need to review with CCSD staff on the particular project)
    a. Submittal
    b. Elementary school gymnasium rack sound system shall follow current structured cabling section 27 10 00
    c. Portable mono sound system equipment (mixer, power strip, media player, processor, amplifier, and drawer) with snake connection to permanent wiring
    d. Portable microphones and instructor headsets
    e. Portable monitor speakers
    f. Permanent performance speakers
    g. Provisions for hearing impaired components
    h. System to be reviewed by CCSD audio specialist
    i. Owner training to include two (2) sessions, one (1) for maintenance personnel and one (1) for school personnel
    j. Permanent wiring in minimum 3/4 inch conduit with speaker wiring separate from input wiring
    k. Sound equipment storage room to be a minimum of 4 feet wide and 6 feet deep accessed from gymnasium
    l. Receptacles in gymnasium on 25 foot on center around to be used for sound system
    m. 12U portable cabinet on casters manufactured by Gator located in sound equipment storage room accessed from gymnasium where permanent wiring terminates to snake connection box
    n. 16 channel digital or analog mixer manufactured by Yamaha (no equivalent) mounted on top of portable cabinet
    o. Nine (9) single 15 ampere receptacle power strip with surge protection, sequencer, and 9 foot cord manufactured by Middle Atlantic mounted in portable cabinet
    p. CD/media player with Bluetooth/USB/SD/Auxiliary/AM-FM Tuner manufactured by Denon (no equivalent) mounted in portable cabinet
    q. Processor with provision for sound being shunted by fire alarm and educational intercommunication
    r. Sound system manufactured by Soundweb London model BLU-50 or Nexia (no equivalent) mounted in portable cabinet
    s. Two (2) channel, 1300 watt at 4 ohms power amplifier manufactured by QSC model RMX 4050a mounted in portable cabinet
    t. Two (2) space drawer without lock manufactured by Middle Atlantic mounted in portable cabinet
    u. Two (2) pack (handheld dynamic unidirectional and belt pack) wireless microphones with headsets for belt packs manufactured by ATW (no equivalent) to be stored in cabinet drawer
    v. Wireless Bluetooth earset for instructor with charging/receiving system manufactured by Samson AirLine (no equivalent) to be stored in instructor office with portable receiver in gymnasium cabled to outlet in instructors office
    w. Three (3) hanging microphones without separate power supply used as portable microphones manufactured by Shure stored in cabinet drawer
    x. Three (3) microphone boom for hanging microphones manufactured by Ultimate Support stored in sound equipment storage room
    y. One (1) handheld cabled microphone with 25 foot cable manufactured by Shure stored in cabinet drawer
    z. Two (2) portable monitor speakers without separate power supplies needed manufactured by Yamaha stored in sound equipment storage room

aa. Two (2) performance speaker columns manufactured by JBL mounted on the walls of either side of the gymnasium near the stage
bb. Snake connection box with 75 foot snake manufactured by RapcoHorizon model 12x2x2 with box mounted in the back left wall at 36 inches above finished floor of sound equipment storage room with snake coil support on left wall
cc. Sound system connection boxes at the stage located on back side of each of the proscenium walls with the following connections; three (3) microphone input, one (1) speaker output (wired together between both sides of the proscenium), one (1) spare speaker output, and line leveler connection

G. MIDDLE SCHOOL CAFETORIUM RACK SOUND SYSTEM
1. Requirements for middle school cafetorium rack sound system (because of the constant product changes and approach, need to review with CCSD staff on the particular project)
a. Submittal
b. Middle school cafetorium rack sound system shall follow current structured cabling section 27 10 00
c. Permanent stereo sound system equipment (mixer, power strip, media player, processor, amplifier, and drawer) in sound room
d. Portable and permanent microphones
e. Portable monitor speakers
f. Permanent performance speakers
g. Provisions for hearing impaired capabilities
h. System to be reviewed by CCSD audio specialist
i. Owner training to include two (2) sessions, one (1) for maintenance personnel and one (1) for school personnel
j. Permanent wiring in minimum 3/4 inch conduit with speaker wiring separate from input wiring
k. Sound room to be a minimum of 10 feet wide and 8 feet deep accessed from and open to cafetorium
l. Dedicated 20 ampere, 120 volt duplex receptacle in sound room
m. 18U permanent cabinet manufactured by Gator located in sound room
n. 32 channel digital or analog mixer manufactured by Yamaha (no equivalent) mounted in sound room
o. Nine (9) single 15 ampere receptacle power strip with surge protection, sequencer, and 9 foot cord manufactured by Middle Atlantic mounted in cabinet
p. CD/media player with Bluetooth/USB/SD/Auxiliary/AM-FM Tuner manufactured by Denon (no equivalent) mounted in cabinet
q. Processor with provision for sound being shunted by fire alarm and educational intercommunication
r. Sound system manufactured by Soundweb London model BLU-50 or Nexia (no equivalent) mounted cabinet
s. Two (2) channel, 1300 watt at 4 ohms power amplifier manufactured by QSC model RMX 4050a mounted in cabinet
t. Two (2) space drawer without lock manufactured by Middle Atlantic mounted in cabinet
u. Two (2) pack (handheld dynamic unidirectional and belt pack) wireless microphones with headsets for belt packs manufactured by ATW (no equivalent) to be stored in cabinet drawer
v. Six (6) hanging microphones without separate power supply manufactured by Shure permanently mounted above stage, evenly distributed
w. Two (2) microphone boom for handheld microphones manufactured by Ultimate Support stored in sound room

x. One (1) handheld cabled microphone with 25 foot cable manufactured by Shure stored in cabinet drawer
y. Two (2) portable monitor speakers without separate power supplies needed manufactured by Yamaha stored in sound room
z. Two (2) performance speaker columns manufactured by JBL mounted on the walls of either side of the cafetorium near the stage
aa. Sound system connection boxes at the stage located on back side of each of the proscenium walls with the following connections; four (4) microphone input, one (1) speaker output (wired separately between sides of proscenium), one (1) spare speaker output, and line leveler connection

H. MIDDLE SCHOOL GYMNASIUM RACK SOUND SYSTEM
1. Requirements for middle school gymnasium rack sound system (because of the constant product changes and approach, need to review with CCSD staff on the particular project)
a. Submittal
b. Middle school gymnasium rack sound system shall follow current structured cabling section 27 10 00
c. Permanent mono sound system equipment (mixer, power strip, media player, processor, amplifier, and drawer)
d. Portable microphones
e. Permanent speakers
f. Provisions for hearing impaired components
g. System to be reviewed by CCSD audio specialist
h. Owner training to include two (2) sessions, one (1) for maintenance personnel and one (1) for school personnel
i. Permanent wiring in minimum 3/4 inch conduit with speaker wiring separate from input wiring
j. Sound equipment room to be a minimum of 4 feet wide and 4 feet deep accessed from gymnasium
k. Dedicated 20 ampere, 120 volt duplex receptacle in sound equipment room
l. 12U floor mounted cabinet manufactured by Gator located in sound equipment room
m. 8 channel digital or analog mixer manufactured by Alesis (no equivalent) mounted in cabinet
n. Nine (9) single 15 ampere receptacle power strip with surge protection, sequencer, and 9 foot cord manufactured by Middle Atlantic mounted in cabinet
o. CD/media player with Bluetooth/USB/SD/Auxiliary/AM-FM Tuner manufactured by Denon (no equivalent) mounted in cabinet
p. Processor with provision for sound being shunted by fire alarm and educational intercommunication
q. Sound system manufactured by Soundweb London model BLU-50 or Nexia (no equivalent) mounted in cabinet
r. Two (2) channel, 1300 watt at 4 ohms power amplifier manufactured by QSC model RMX 4050a mounted in cabinet
s. Two (2) space drawer without lock manufactured by Middle Atlantic mounted in cabinet
t. Two (2) pack (handheld dynamic unidirectional and belt pack) wireless microphones with headsets for belt packs manufactured by ATW (no equivalent) to be stored in drawer
u. Wireless Bluetooth earset for instructor with charging/receiving system manufactured by Samson AirLine (no equivalent) to be stored in instructor’s office with portable receiver in gymnasium cabled to outlet in instructor’s office
v. One (1) handheld cabled microphone with 25 foot cable manufactured by Shure stored in cabinet drawer

w. Three (3) permanent loud speakers manufactured by Electro-Voice mounted on the walls near ceiling opposite the bleachers equally spaced
x. Sound system connection box at center of bleacher with the following connections; two (2) microphone input, one (1) speaker output, one (1) spare speaker output, one (auxiliary input) and line leveler connection

I. HIGH SCHOOL GYMNASIUM RACK SOUND SYSTEM
1. Requirements for high school gymnasium rack sound system (because of the constant product changes and approach, need to review with CCSD staff on the particular project))
a. Submittal
b. High school gymnasium rack sound system shall follow current structured cabling section 27 10 00
c. Permanent mono sound system equipment (mixer, power strip, media player, processor, amplifiers, and drawer)
d. Portable microphones
e. Permanent speakers
f. Provisions for hearing impaired components
g. System to be reviewed by CCSD audio specialist
h. Owner training to include two (2) sessions, one (1) for maintenance personnel and one (1) for school personnel
i. Permanent wiring in minimum 3/4 inch conduit with speaker wiring separate from input wiring
j. Sound equipment room to be a minimum of 4 feet wide and 4 feet deep accessed from gymnasium
k. Dedicated 20 ampere, 120 volt duplex receptacle in sound equipment room
l. 18U floor mounted cabinet manufactured by Gator located in sound equipment room
m. 8 channel digital or analog mixer manufactured by Alesis (no equivalent) mounted in cabinet
n. Nine (9) single 15 ampere receptacle power strip with surge protection, sequencer, and 9 foot cord manufactured by Middle Atlantic mounted in cabinet
o. CD/media player with Bluetooth/USB/SD/Auxiliary/AM-FM Tuner manufactured by Denon (no equivalent) mounted in cabinet
p. Processor with provision for sound being shunted by fire alarm and educational intercommunication
q. Sound system manufactured by Soundweb London model BLU-50 or Nexia (no equivalent) mounted in cabinet
r. Two (2), two (2) channel, 1300 watt at 4 ohms power amplifier manufactured by QSC model RMX 4050a mounted in cabinet
s. Two (2) space drawer without lock manufactured by Middle Atlantic mounted in cabinet
t. Two (2) pack (handheld dynamic unidirectional and belt pack) wireless microphones with headsets for belt packs manufactured by ATW (no equivalent) to be stored in drawer
u. Wireless Bluetooth earset for instructor with charging/receiving system manufactured by Samson AirLine (no equivalent) to be stored in instructors office with portable receiver in gymnasium cabled to outlet in instructors office
v. One (1) handheld cabled microphone with 25 foot cable manufactured by Shure stored in cabinet drawer
w. 9 dB or better antenna for CD/media player with Bluetooth/USB/SD/Auxiliary/AM-FM Tuner remote control mounted on ceiling with wire guard
x. Six (6) permanent 15 inch variable intensity loud speakers manufactured by Electro-Voice mounted on ceiling three (3) locations along the center of the gymnasium equally spaced parallel with the bleachers

y. Sound system connection box at center of both bleachers with the following connections; two (2) microphone input, one (1) speaker output, one (1) spare speaker output, one (auxiliary input) and line leveler connection

J. HIGH SCHOOL AUDITORIUM RACK SOUND SYSTEM
1. Requirements for high school auditorium rack sound system (because of the constant product changes and approach, need to review with CCSD staff on the particular project)
a. Submittal
b. High school auditorium rack sound system shall follow current structured cabling section 27 10 00
c. Permanent stereo sound system equipment (mixer, power strip, media player, processor, amplifier, and drawer) in sound room
d. Portable and permanent microphones
e. Portable monitor speakers
f. Permanent performance speakers
g. Provisions for hearing impaired capabilities
h. System to be reviewed by CCSD audio specialist
i. Owner training to include two (2) sessions, one (1) for maintenance personnel and one (1) for school personnel
j. Permanent wiring in minimum 3/4 inch conduit with speaker wiring separate from input wiring
k. Sound room to be a minimum of 15 feet wide and 8 feet deep accessed from and open to auditorium
l. Dedicated 20 ampere, 120 volt duplex receptacle in sound room
m. 24U permanent cabinet manufactured by Gator located in sound room
n. 64 channel digital or analog mixer manufactured by Yamaha (no equivalent) mounted in sound room
o. Two (2), nine (9) single 15 ampere receptacle power strip with surge protection, sequencer, and 9 foot cord manufactured by Middle Atlantic mounted in cabinet
p. CD/media player with Bluetooth/USB/SD/Auxiliary/AM-FM Tuner manufactured by Denon (no equivalent) mounted in portable cabinet
q. Processor with provision for sound being shunted by fire alarm and educational intercommunication
r. Sound system manufactured by Soundweb London model BLU-50 or Nexia (no equivalent) mounted in cabinet
s. Four (4), two (2) channel, 1300 watt at 4 ohms power amplifier manufactured by QSC model RMX 4050a mounted in cabinet
t. Two (2), two (2) space drawer without lock manufactured by Middle Atlantic mounted in cabinet
u. Four (4) pack (handheld dynamic unidirectional and belt pack) wireless microphones with headsets for belt packs manufactured by ATW (no equivalent) to be stored in cabinet drawer
v. Six (6) hanging microphones without separate power supply manufactured by Shure permanently mounted above stage, evenly distributed
w. Four (4) microphone boom for handheld microphones manufactured by Ultimate Support stored in sound room
x. Two (2) handheld cabled microphone with 25 foot cable manufactured by Shure stored in cabinet drawer
y. Four (4) portable monitor speakers without separate power supplies needed manufactured by Yamaha stored in sound room
z. Two (2) performance speakers line array type manufactured by JBL mounted on the walls of either side of the auditorium near the stage

aa. Sound system connection boxes at the stage located on back side of each of the proscenium walls with the following connections; eight (8) microphone input, two (2) speaker output (wired separately between sides of proscenium and in each of the boxes), two (2) spare speaker output, and line leveler connection

END OF SECTION

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SECTION 27 53 19

DISTRIBUTED ANTENNA SYSTEM

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. PURPOSE
   1. The purpose of this document is to provide design guidelines for architects, engineers, consultants, and contractors with an understanding of the minimum requirements for Telecommunications Infrastructure and other Technology systems for any building related project within the Cherry Creek School District (CCSD). If the building is existing, the requirements outlined below should be met to best of the ability of the design team and/or contractor. If the building is new construction, the requirements outlined below must be adhered to unless written approval is provided from CCSD IST prior to design completion.

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. SUMMARY – SECTION INCLUDES
   1. Distributed Antenna System

E. DISTRIBUTED ANTENNA SYSTEM
   1. Requirements for distributed antenna system
      a. Submittal
      b. Distributed antenna system shall follow current structured cabling section 27 10 00. Some CCSD facilities require a distributed antenna or bi-directional amplification (BDA) system to support first responder radio signals. Historically, the building is surveyed by the local authority having jurisdiction (AHJ) and determined if a distributed antenna or bi-directional amplification system is required. During this time, CCSD Facilities or the construction team will communicate to the design team that a system is required. If required, then CCSD may require the design team to provide a performance specification for this system.
      c. Fire detection and alarm system to monitor the system

d. Refer to responsibility matrix below

MATRIX OF CONSTRUCTION RESPONSIBILITIES

THE RESPONSIBILITIES LISTED HEREIN ARE PROVIDED AS A RECOMMENDATION AND DO NOT SUPERSEDE OR REPLACE ANY CONTRACTS, OR OTHERWISE DEFINED RESPONSIBILITIES, BETWEEN THE DESIGNATED PARTIES. IN ADDITION, THE INFORMATION IS MEANT TO INDICATE GENERAL RESPONSIBILITY FOR A SCOPE OF WORK AND IN NO WAY DISALLOWS THE RESPONSIBLE PARTY TO SUBCONTRACT THE SCOPE.

RESPONSIBLE PARTY	GENERAL CONTRACTOR		ELECTRICAL CONTRACTOR		TELECOM CONTRACTOR		LOW VOLTAGE CONTRACTOR		AUDIO-VIDEO CONTRACTOR		SECURITY CONTRACTOR		OWNER		NOTES
SCOPE OF WORK	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	
BUDGET OF WORK	CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		FIX-FURN-EQUIP		
SITE															
INCOMING SERVICE PROVIDER CABLING & COORDINATION													X	X	1
EXTERIOR CONDUIT PATHWAY / DUCTBANK			X	X											
INTERIOR INFRASTRUCTURE															
GROUNDING & BONDING			X	X	X	X									3, 4
INTERIOR CONDUIT PATHWAY			X	X											
BACKBOX / JUNCTION BOX			X	X											
FLOOR BOX / POKE THROUGH			X	X		X									5
CABLE TRAY			X	X											
J-HOOK / SLING					X	X									
SLEEVE / CONDUIT PENETRATIONS			X	X	X	X									6, 7
TELECOMMUNICATIONS															
PLYWOOD BACKBOARD	X	X													
LADDER RACK / LADDER RUNWAY / ACCESSORIES					X	X									
RACK / FRAME / CABINET (TELECOM)					X	X									
WIREMANAGER					X	X									
FIBER PATCH PANEL					X	X									
COPPER PATCH PANEL					X	X									
POWER DISTRIBUTION UNIT (PDU)					X	X									
UNINTERRUPTIBLE POWER SUPLY (UPS)					X	X									
MISCELLANEOUS RACK COMPONENTS (DRAWER, SHELF, ETC.)					X	X									
BACKBONE CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
HORIZONTAL CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
FACEPLATE / JACK / SURFACE MOUNT BOX					X	X									
PATCH CABLE (INTERIOR TO TELECOMMUNICATIONS ROOM)					X									X	
PATCH CABLE (END DEVICE / OUTLET)					X	X		X		X		X		X	2
LABELING					X	X									
MEDIA CONVERTERS / COPPER EXTENDERS FOR NETWORK CABLING					X	X									
WIRELESS ACCESS POINT (WAP)						X							X		
BUILDING NETWORK (LAN) EQUIPMENT (SWITCH, HEADEND, ETC.)													X	X	9
PERIPHERAL EQUIPMENT (PHONE, PRINTER, PC, ETC.)													X	X	
LOW VOLTAGE (LV)															
PAGING / PUBLIC ADDRESS							X	X							
CELLULAR DISTRIBUTED ANTENNA SYSTEM (DAS)	X	X													
BUILDING NETWORK (LAN) CABLING TO LV SYSTEM(S)					X	X									
AUDIO VISUAL (AV)															
RACK / FRAME / CABINET (AV)									X	X					
AMPLIFIER / CONTROLLER / PROCESSOR / MATRIX									X	X					
MICROPHONE									X	X					
FACEPLATE / JACK									X	X					
CABLING (NON-NETWORK)									X	X					
SPEAKER									X	X					
DISPLAY & MOUNT									X	X					
DISPLAY BACKING	X	X													
PROJECTOR									X	X					
PROJECTOR SCREEN									X	X					
AUDIO VIDEO NETWORK EQUIPMENT (SWITCHES AND CABLING)									X	X					9
BUILDING NETWORK (LAN) CABLING TO AUDIO VIDEO SYSTEM(S)					X	X									9
SECURITY - ACCESS CONTROL SYSTEM (ACS)															
ACS HEADEND / CONTROLLER / PANEL											X	X			
ACS SOFTWARE, PROGRAMMING, & INTEGRATION											X	X	X	X	
CARD READER / KEYPAD AND LICENSE (AUTHENTICATION DEVICE)											X	X			
REQUEST TO EXIT (WHEN NOT INTEGRAL TO DOOR HARDWARE)											X	X			
INTERCOM & INTERCOM MASTER STATION											X	X			
DOOR POSITION SWITCH											X	X			
DOOR RELEASE BUTTON											X	X			
DOOR HARDWARE / COMPONENTS	X	X													
BUILDING NETWORK (LAN) CABLING TO ACS					X	X									9
SECURITY - VIDEO SURVIELLANCE SYSTEM (VSS)															
VSS NETWORK VIDEO RECORDER (NVR)													X	X	
VSS SOFTWARE, PROGRAMMING, & INTEGRATION													X	X	
CAMERA AND LICENSE											X	X			
BUILDING NETWORK (LAN) CABLING TO VSS					X	X									9
SECURITY - INTRUSION DETECTION SYSTEM (IDS)															
ID HEADEND / CONTROLLER / PANEL											X	X			
ID SOFTWARE, PROGRAMMING, & INTEGRATION											X	X			
MOTION SENSOR &/OR GLASS BREAK SENSORS											X	X			
LOCK-DOWN BUTTON											X	X			
PANIC / DURESS BUTTON											X	X			
AUTO-DIALER & DIAL DESTINATION COORDINATION											X	X			
BUILDING NETWORK (LAN) CABLING TO IDS					X	X									9

NOTES:

1. CONTRACTOR SHALL COORDINATE WITH OWNER REGARDING TIMELINE OF INSTALLATION AND REQUIREMENTS FOR INSTALLATION TO ENSURE A TIMLEY INSTALLATION.
2. THE PARTY RESPONSIBLE FOR INSTALLING THE END DEVICE (PC, CAMERA, WAP, ETC.) SHALL BE RESPONSIBLE FOR INSTALLING THE END-OF-RUN PATCH CABLE. AFTER INSTALLATION, VERIFICATION OF OPERABILITY IS REQUIRED.
3. THE ELECTRICAL CONTRACTOR SHALL i) EXTEND THE BUILDING GROUND TO EACH TELECOMMUNICATION SPACE ii) PROVIDE AND INSTALL THE BUSBAR(S), GROUNDING CABLES, AND ASSOCIATED EQUIPMENT, iii) AND ENSURE EACH TELECOMMUNICATION SPACE HAS PROPER ACCESS TO BUILDING GROUND THROUGH THE LOCAL BUSBAR AS SHOWN IN THE DRAWINGS.
4. FOR ALL DEVICES, EQUIPMENT, PATHWAY, AND OTHER SUCH MATERIAL REQUIRED TO BE GROUNDED, THE CONTRACTOR/PARTY, WITH WHICH THE DEVICE, EQUIPMENT, PATHWAY OR OTHER SUCH MATERIAL WAS INSTALLED BY, SHALL BE RESPONSIBLE FOR ITS PROPER BONDING AND GROUNDING.
5. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION AND INSTALLATION OF ALL FLOOR BOXES AND POKE THROUGHS, AS WELL AS ALL CONDUIT/PATHWAY REQUIREMENTS PERTAINING TO IT, REGARDLESS IF THERE IS POWER CABLING INCLUDED AT DEVICE. THE TELECOM CONTRACTOR SHALL COORDINATE WITH DRAWINGS AND ELECTRICAL CONTRACTOR TO ENSURE LOW VOLTAGE INFRASTRUCTURE AND CABLING REQUIREMENTS ARE MET AND SHALL PROVIDE AND INSTALL ALL CABLING AND FACEPLATE/TERMINATION EQUIPMENT PERTAINING TO DEVICE.
6. FOR ALL PENETRATIONS SHOWN IN DRAWINGS, THE ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL. THE ELECTRICAL CONTRACTOR SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE.
7. ALL PENETRATIONS NOT SHOWN ON DRAWINGS, BUT REQUIRED FOR CABLING INSTALLATION, SHALL BE PROVIDED AND INSTALLED BY THE CABLING INSTALLATION CONTRACTOR/TEAM. FOR FIRE-RATED PENETRATIONS, THE CABLE INSTALLATION CONTRACTOR/TEAM SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE. AFTER ALL CABLING IS INSTALLED, TESTED, AND ACCEPTED, THE INTERIOR OF EACH PENETRATION SHALL BE FIRE-RATED TO MATCH OR EXCEED THE PENETRATED MATERIAL.
8. IT IS ACCEPTABLE FOR THE CONTRACTOR TO REUSE AN EXISTING DEVICE WITH OWNER APPROVAL. COORDINATE WITH OWNER PRIOR TO ANY NEW DEVICE PROCUREMENT TO RECORD ALL DEVICES THAT MAY BE REUSED. FOR ALL DEVICES SCHEDULED FOR REUSE THAT REPLACE AN ITEM SCHEDULED FOR NEW, A CREDIT SHALL BE GIVEN TO OWNER FOR ITEM REPLACEMENT.
9. THE BUILDING NETWORK IS THE LOCAL AREA NETWORK (LAN) OF THE BUILDING AND CONNECTS DIRECTLY TO THE INCOMING SERVICE PROVIDER; IT PROVIDES GENERAL ACCESS TO THE WIDE AREA NETWORK (WAN). OTHER SYSTEMS MAY UTILIZE NETWORK EQUIPMENT TO SUPPORT THEIR SPECIFIC NEEDS, HOWEVER, THIS EQUIPMENT IS SEPARATE AND DISTINCT FROM THE BUILDING NETWORK (LAN) AND ASSOCIATED

END OF SECTION

SECTION 28 20 00

VIDEO SURVEILLANCE

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. PURPOSE
   1. The purpose of this document is to provide design guidelines for architects, engineers, consultants, and contractors with an understanding of the minimum requirements for Telecommunications Infrastructure and other Technology systems for any building related project within the Cherry Creek School District (CCSD). If the building is existing, the requirements outlined below should be met to best of the ability of the design team and/or contractor. If the building is new construction, the requirements outlined below must be adhered to unless written approval is provided from CCSD IST prior to design completion.

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project. Request current equipment and component list from CCSD.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. SUMMARY – SECTION INCLUDES
   1. Video Surveillance

E. VIDEO SURVEILLANCE
   1. Requirements for video surveillance
      a. Submittal
      b. Video surveillance system shall follow current structured cabling section 27 10 00. CCSD IST is responsible for the video surveillance systems throughout the school district. In addition, CCSD IST has been contracting directly with one or two preferred contractors to install the cameras. CCSD IST utilizes Video Insight for the Video Management Software and purchase camera licensing directly from the manufacturer. CCSD IST has a central storage set up for video storage located in the data center located at the ISF building and add to it as needed. CCSD IST is responsible for providing programming, licensing, and video storage for the video surveillance system. The cameras for the video surveillance system needs to be verified whether CCSD IST will provide them or if they are provided by the approved manufacturer. The video surveillance system provider is responsible for configuring of parameters to allow for accessibility such as IP address, phone numbers, and username/password. Only the cabling and pathways for the system is to be included in any design and installation unless directed otherwise by CCSD IST.
      c. Each camera location shall have one Category 6 cable meeting the horizontal cabling standards listed in section 27 10 00. The cabling shall be provided by the cabling contractor and shall meet the same 20 year certification requirements outlined for the voice and data cabling. In addition, all pathway requirements in section 27 10 00 apply to camera cabling. Motion sensors located throughout the space. Typically located near each entry/exit as well as main corridors and stairwells. CCSD Security and IST will provide final locations during design.
      d. Camera locations are often based off of the usage of the building. Typically, all building entry/exits have an interior camera viewing the entry/exit. Some main corridors typically have camera coverage as well as some specialty areas. The design team to coordinate locations of all cameras with CCSD Security and IST during the design phase of the project and cabling and pathway requirements communicated in the construction documents.
      e. Provide preparatory work by all trades for exterior camera locations, when possible, a recess mounted 1900 electrical box with a single gang mud ring to bring it flush to the finished surface. The box to be located near the corners of the building with 18 inch radius clear access around, both inside and outside of the building.

f. Refer to responsibility matrix below

MATRIX OF CONSTRUCTION RESPONSIBILITIES

THE RESPONSIBILITIES LISTED HEREIN ARE PROVIDED AS A RECOMMENDATION AND DO NOT SUPERSEDE OR REPLACE ANY CONTRACTS, OR OTHERWISE DEFINED RESPONSIBILITIES, BETWEEN THE DESIGNATED PARTIES. IN ADDITION, THE INFORMATION IS MEANT TO INDICATE GENERAL RESPONSIBILITY FOR A SCOPE OF WORK AND IN NO WAY DISALLOWS THE RESPONSIBLE PARTY TO SUBCONTRACT THE SCOPE.

RESPONSIBLE PARTY	GENERAL CONTRACTOR		ELECTRICAL CONTRACTOR		TELECOM CONTRACTOR		LOW VOLTAGE CONTRACTOR		AUDIO-VIDEO CONTRACTOR		SECURITY CONTRACTOR		OWNER		NOTES
SCOPE OF WORK	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	
BUDGET OF WORK	CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		FIX-FURN-EQUIP		
SITE															
INCOMING SERVICE PROVIDER CABLING & COORDINATION													X	X	1
EXTERIOR CONDUIT PATHWAY / DUCTBANK			X	X											
INTERIOR INFRASTRUCTURE															
GROUNDING & BONDING			X	X	X	X									3, 4
INTERIOR CONDUIT PATHWAY			X	X											
BACKBOX / JUNCTION BOX			X	X											
FLOOR BOX / POKE THROUGH			X	X		X									5
CABLE TRAY			X	X											
J-HOOK / SLING					X	X									
SLEEVE / CONDUIT PENETRATIONS			X	X	X	X									6, 7
TELECOMMUNICATIONS															
PLYWOOD BACKBOARD	X	X													
LADDER RACK / LADDER RUNWAY / ACCESSORIES					X	X									
RACK / FRAME / CABINET (TELECOM)					X	X									
WIREMANAGER					X	X									
FIBER PATCH PANEL					X	X									
COPPER PATCH PANEL					X	X									
POWER DISTRIBUTION UNIT (PDU)					X	X									
UNINTERRUPTIBLE POWER SUPLY (UPS)					X	X									
MISCELLANEOUS RACK COMPONENTS (DRAWER, SHELF, ETC.)					X	X									
BACKBONE CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
HORIZONTAL CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
FACEPLATE / JACK / SURFACE MOUNT BOX					X	X									
PATCH CABLE (INTERIOR TO TELECOMMUNICATIONS ROOM)					X									X	
PATCH CABLE (END DEVICE / OUTLET)					X	X		X		X		X		X	2
LABELING					X	X									
MEDIA CONVERTERS / COPPER EXTENDERS FOR NETWORK CABLING					X	X									
WIRELESS ACCESS POINT (WAP)						X							X		
BUILDING NETWORK (LAN) EQUIPMENT (SWITCH, HEADEND, ETC.)													X	X	9
PERIPHERAL EQUIPMENT (PHONE, PRINTER, PC, ETC.)													X	X	
LOW VOLTAGE (LV)															
PAGING / PUBLIC ADDRESS							X	X							
CELLULAR DISTRIBUTED ANTENNA SYSTEM (DAS)	X	X													
BUILDING NETWORK (LAN) CABLING TO LV SYSTEM(S)					X	X									
AUDIO VISUAL (AV)															
RACK / FRAME / CABINET (AV)									X	X					
AMPLIFIER / CONTROLLER / PROCESSOR / MATRIX									X	X					
MICROPHONE									X	X					
FACEPLATE / JACK									X	X					
CABLING (NON-NETWORK)									X	X					
SPEAKER									X	X					
DISPLAY & MOUNT									X	X					
DISPLAY BACKING	X	X													
PROJECTOR									X	X					
PROJECTOR SCREEN									X	X					
AUDIO VIDEO NETWORK EQUIPMENT (SWITCHES AND CABLING)									X	X					9
BUILDING NETWORK (LAN) CABLING TO AUDIO VIDEO SYSTEM(S)					X	X									9
SECURITY - ACCESS CONTROL SYSTEM (ACS)															
ACS HEADEND / CONTROLLER / PANEL											X	X			
ACS SOFTWARE, PROGRAMMING, & INTEGRATION											X	X	X	X	
CARD READER / KEYPAD AND LICENSE (AUTHENTICATION DEVICE)											X	X			
REQUEST TO EXIT (WHEN NOT INTEGRAL TO DOOR HARDWARE)											X	X			
INTERCOM & INTERCOM MASTER STATION											X	X			
DOOR POSITION SWITCH											X	X			
DOOR RELEASE BUTTON											X	X			
DOOR HARDWARE / COMPONENTS	X	X													
BUILDING NETWORK (LAN) CABLING TO ACS					X	X									9
SECURITY - VIDEO SURVIELLANCE SYSTEM (VSS)															
VSS NETWORK VIDEO RECORDER (NVR)													X	X	
VSS SOFTWARE, PROGRAMMING, & INTEGRATION													X	X	
CAMERA AND LICENSE											X	X			
BUILDING NETWORK (LAN) CABLING TO VSS					X	X									9
SECURITY - INTRUSION DETECTION SYSTEM (IDS)															
ID HEADEND / CONTROLLER / PANEL											X	X			
ID SOFTWARE, PROGRAMMING, & INTEGRATION											X	X			
MOTION SENSOR &/OR GLASS BREAK SENSORS											X	X			
LOCK-DOWN BUTTON											X	X			
PANIC / DURESS BUTTON											X	X			
AUTO-DIALER & DIAL DESTINATION COORDINATION											X	X			
BUILDING NETWORK (LAN) CABLING TO IDS					X	X									9

NOTES:

1. CONTRACTOR SHALL COORDINATE WITH OWNER REGARDING TIMELINE OF INSTALLATION AND REQUIREMENTS FOR INSTALLATION TO ENSURE A TIMLEY INSTALLATION.
2. THE PARTY RESPONSIBLE FOR INSTALLING THE END DEVICE (PC, CAMERA, WAP, ETC.) SHALL BE RESPONSIBLE FOR INSTALLING THE END-OF-RUN PATCH CABLE. AFTER INSTALLATION, VERIFICATION OF OPERABILITY IS REQUIRED.
3. THE ELECTRICAL CONTRACTOR SHALL i) EXTEND THE BUILDING GROUND TO EACH TELECOMMUNICATION SPACE ii) PROVIDE AND INSTALL THE BUSBAR(S), GROUNDING CABLES, AND ASSOCIATED EQUIPMENT, iii) AND ENSURE EACH TELECOMMUNICATION SPACE HAS PROPER ACCESS TO BUILDING GROUND THROUGH THE LOCAL BUSBAR AS SHOWN IN THE DRAWINGS.
4. FOR ALL DEVICES, EQUIPMENT, PATHWAY, AND OTHER SUCH MATERIAL REQUIRED TO BE GROUNDED, THE CONTRACTOR/PARTY, WITH WHICH THE DEVICE, EQUIPMENT, PATHWAY OR OTHER SUCH MATERIAL WAS INSTALLED BY, SHALL BE RESPONSIBLE FOR ITS PROPER BONDING AND GROUNDING.
5. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION AND INSTALLATION OF ALL FLOOR BOXES AND POKE THROUGHS, AS WELL AS ALL CONDUIT/PATHWAY REQUIREMENTS PERTAINING TO IT, REGARDLESS IF THERE IS POWER CABLING INCLUDED AT DEVICE. THE TELECOM CONTRACTOR SHALL COORDINATE WITH DRAWINGS AND ELECTRICAL CONTRACTOR TO ENSURE LOW VOLTAGE INFRASTRUCTURE AND CABLING REQUIREMENTS ARE MET AND SHALL PROVIDE AND INSTALL ALL CABLING AND FACEPLATE/TERMINATION EQUIPMENT PERTAINING TO DEVICE.
6. FOR ALL PENETRATIONS SHOWN IN DRAWINGS, THE ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL. THE ELECTRICAL CONTRACTOR SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE.
7. ALL PENETRATIONS NOT SHOWN ON DRAWINGS, BUT REQUIRED FOR CABLING INSTALLATION, SHALL BE PROVIDED AND INSTALLED BY THE CABLING INSTALLATION CONTRACTOR/TEAM. FOR FIRE-RATED PENETRATIONS, THE CABLE INSTALLATION CONTRACTOR/TEAM SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE. AFTER ALL CABLING IS INSTALLED, TESTED, AND ACCEPTED, THE INTERIOR OF EACH PENETRATION SHALL BE FIRE-RATED TO MATCH OR EXCEED THE PENETRATED MATERIAL.
8. IT IS ACCEPTABLE FOR THE CONTRACTOR TO REUSE AN EXISTING DEVICE WITH OWNER APPROVAL. COORDINATE WITH OWNER PRIOR TO ANY NEW DEVICE PROCUREMENT TO RECORD ALL DEVICES THAT MAY BE REUSED. FOR ALL DEVICES SCHEDULED FOR REUSE THAT REPLACE AN ITEM SCHEDULED FOR NEW, A CREDIT SHALL BE GIVEN TO OWNER FOR ITEM REPLACEMENT.
9. THE BUILDING NETWORK IS THE LOCAL AREA NETWORK (LAN) OF THE BUILDING AND CONNECTS DIRECTLY TO THE INCOMING SERVICE PROVIDER; IT PROVIDES GENERAL ACCESS TO THE WIDE AREA NETWORK (WAN). OTHER SYSTEMS MAY UTILIZE NETWORK EQUIPMENT TO SUPPORT THEIR SPECIFIC NEEDS, HOWEVER, THIS EQUIPMENT IS SEPARATE AND DISTINCT FROM THE BUILDING NETWORK (LAN) AND ASSOCIATED

END OF SECTION

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SECTION 28 30 00

FIRE DETECTION AND ALARM SYSTEM

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.
   2. Refer to Division 26 for conduit requirements.

B. SUMMARY – SECTION INCLUDES
   1. Fire Detection and Alarm System
   2. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

C. FIRE DETECTION AND ALARM SYSTEM
   1. Requirements for fire detection and alarm system
      a. Submittal
      b. Fire Detection and Alarm System to meet the requirements of the State of Colorado, local jurisdictional authority, and the following as a minimum
      c. Manufactured by Notifier or Simplex
      d. Detection as required and noted
      e. Interface with kilns
      f. Interface with kitchen hoods
      g. Interface with elevators
      h. Interface with rack sound systems to shunt them during alarm condition
      i. Interface with auditorium lighting system transfer switch
      j. Design by supplier, where existing system is replaced review existing program and incorporate existing to remain devices and areas covered
      k. Design sealed by supplier engineer
      l. Meet the requirements of the local jurisdiction
      m. Duct mounted smoke detectors addressable
      n. Air handling shut down via control module and not the local duct mounted smoke detector contacts
      o. Spare battery capacity of 20 percent
      p. Detection device and remote unit interface (RUI) wiring in conduit
      q. Notification device wiring in plenum or conduit
      r. Visual alarm to comply with Americans with Disabilities Act
      s. Full testing prior to fire department testing
      t. Initiation Device:
         1. Smoke Detection
            i Smoke detectors in all electrical rooms and communication equipment rooms
            ii Smoke detectors in corridors where the building is not protected by fire sprinkler system. If the building is protected by fire sprinkler system, then apply the exception in the International Fire Code that allows the smoke detectors to be omitted
            iii Smoke detector above the fire alarm control panel
            iv Smoke detectors in all kindergarten classrooms and other rooms used for pre-school children and daycare purposes
            v Smoke detectors in all rooms used for children with special needs
            vi Smoke detectors in all computer classrooms
            vii Smoke detectors in elevator lobbies, elevator machine room, and top of shaft for elevator recall

viii Smoke detectors on either side of doors held open with magnetic hold open devices in accordance with NFPA
ix Smoke detectors required for smoke damper control and release of roll-up doors. Coordinate with specifier and installer of roll-up doors to provide remote reset of door release device
x Wire guards for devices located in gymnasiums.

2. Heat Detection
   i Heat detectors located in all areas where detection is required, but not suitable for smoke detectors
   ii Heat detectors located in all mechanical equipment rooms
   iii 135 degrees Fahrenheit rate of rise heat detectors in chemical storage areas, science preparation rooms, and science classrooms
   iv In buildings not protected by fire sprinkler system, heat detectors set at the highest programmable fixed temperature possible in boiler rooms, chiller rooms, and similar rooms
   v Adjust sequence for electric kiln only, electric kiln with gas kiln, or gas kiln. Kiln rooms to have two (2) thermal detectors, one (1) fixed temperature of 135 degrees Fahrenheit, and one (1) fixed temperature of 200 degrees Fahrenheit. The 135 degree device to initiate supervisory alarm, shutdown electric kilns, shutdown of natural gas, and electric kiln fans. The 200 degree device to initiate evacuation alarm and shutdown of kiln hood fans. Refer to previous kiln wiring diagrams for additional information (coordinate interface with building automation system designer/installer, electrical contractor, and fire alarm design/installer).
   vi Heat detectors in elevator machine room and elevator shaft adjacent to sprinkler heads at a rating above that of the sprinkler head for shunt-trip of power to the elevator machinery
   vii Wire guards for devices located in gymnasiums

3. Duct Mounted Smoke Detection
   i Intelligent analog/addressable type that initiate a supervisory alarm duct mounted smoke detectors
   ii Duct mounted smoke detectors sampling return air for all air handling equipment of more than 2,000 cubic feet per minute of air volume. Duct mounted smoke detection for all air handling equipment with a combined capacity of more than 2,000 cubic feet per minute of air volume serving the same area.
   iii All air handling equipment of more than 15,000 cubic feet per minute of volume serving two (2) or more stories duct mounted smoke detectors sampling return air at each return air riser connections
   iv Duct mounted smoke detectors located within five (5) feet of smoke dampers unless an approved alternate method can be applied

u. Manual pull station:
   1. Dual action type manual pull stations.
   2. In general, minimize quantity of manual pull stations to code required only.
   3. In existing buildings, remove as many of the existing manual pull stations as possible.
   4. In non-fire sprinkler protected buildings, manual pull stations located at building exits from every floor, and at doors with direct exit from building.
   5. In fire sprinkler protected buildings, manual pull stations locate one in a supervised location.
   6. Manual pull stations mounted at 48 inches above finished floor to operating mechanism.

7. Wire guards for devices located in gymnasiums.

v. Carbon Monoxide (CO) Sensor:
   1. Part of smoke detector or thermal detector base with ten (10) year module life and initiates supervisory alarm carbon monoxide (CO) detectors. Fire alarm control panel to report condition of module including time left.
   2. Carbon monoxide detectors located in first room served by natural gas heat air handling equipment
   3. Carbon monoxide detectors located in boiler and other mechanical equipment rooms with gas fired equipment
   4. Carbon monoxide detectors located in kiln rooms shall override building automation system to initiate the starting of kiln hood exhaust fans. Refer to previous kiln wiring diagrams for additional information (coordinate interface with building automation system designer/installer, electrical contractor, and fire alarm design/installer).

w. Fire Sprinkler Monitoring:
   1. Monitor all fire sprinkler water flow switches with a dedicated homerun to the fire alarm control panel
   2. Monitor all fire sprinkler water valve tamper switches with addressable monitor module

x. Distributed Antenna System Monitoring:
   1. Monitor the distributed antenna system components and report supervisory alarm

y. Notification Device:
   1. Conventional speakers and speaker/strobes (addressable not acceptable) to be located to provide a minimum of 15 dB above ambient sound levels throughout all portions of the building. Voice intelligibility to be verified after installation.
   2. Ceiling mounted speaker/strobes are preferred over wall mounted in instructional spaces, toilet rooms, and offices. Locate in center of room as much as possible, but not to exceed 5 feet in any direction from the center unless approved by the engineer or jurisdictional authority. When ceiling mounting is not practical, locate on wall with the bottom of the strobe lens at 80 inches above finished floor or top at 6 inches below the ceiling, whichever is lower. For specific limited applications, mount on wall strobe lens at 96 inches above finished floor. Each location approved in writing by the engineer or jurisdictional authority.
   3. Speaker/strobes located in all common public areas, including corridors, instructional spaces, kindergarten classrooms, pre-school classroom, toilet rooms (except single water closets), open office areas, mechanical equipment rooms and high-noise areas and all areas where more than one person occupancy
   4. Strobes located in clinics, conference rooms, smaller toilet rooms, copy rooms, work rooms, storage rooms greater than 400 square feet, storage rooms where high occupant usage levels anticipated under normal conditions, and in offices capable of more than one occupant
   5. Exterior weatherproof horn/strobe at fire department response point and any playground areas mounted at 10 feet above grade. The horns able to be silenced.
   6. Temporal code 4 for carbon monoxide initiated alarm without separate signaling devices
   7. Wire guards for devices located in gymnasiums

z. Fire Detection and Alarm Cabling:
    1. Minimum size fire alarm cable with stripping as follows.
    2. 16/2 red with green stripe for speakers
    3. 14/2 red with yellow stripe for strobes
    4. 14/2 red with purple stripe for 24 volts DC power
    5. 18/2 red with no stripe for SLC (IdNET)
    6. All initiation device wiring in minimum 3/4 inch conduit or Type MC-FPLP Cable in existing building with approval
    7. All notification device wiring may be plenum wiring with proper support.

END OF SECTION

SECTION 28 50 10

ACCESS CONTROL AND INTRUSION DETECTION

PART 1 – GENERAL

A. SUBJECT TO CHANGE
   1. These standards are subject to change. Verify that the latest are being used. Product manufacturers listed is the basis of design or equivalent unless noted otherwise.

B. PURPOSE
   1. The purpose of this document is to provide design guidelines for architects, engineers, consultants, and contractors with an understanding of the minimum requirements for Telecommunications Infrastructure and other Technology systems for any building related project within the Cherry Creek School District (CCSD). If the building is existing, the requirements outlined below should be met to best of the ability of the design team and/or contractor. If the building is new construction, the requirements outlined below must be adhered to unless written approval is provided from CCSD IST prior to design completion.

C. DESIGN REQUIREMENTS
   1. The design of the structured cabling and other technology systems for a new construction or renovation project shall be completed by a pre-approved CCSD Facilities and CCSD IST engineer/consultant. The engineer/consultant is typically selected by CCSD Facilities as a sub consultant to the Architect of the project, but can also be selected by CCSD IST directly if the project is technology systems specific. The engineer/consultant shall have an RCDD on staff and shall be responsible for the daily management of the project and its design. The engineer/consultant shall coordinate with the Architect and CCSD IST for a minimum of two (2) plan reviews during the design phase of the project. In addition, the engineer/consultant may be requested to include standard Contract Administration services including but not limited to Request for Information responses, Submittal Reviews, Site Observations, Final Punch walk, and review of contractor provided close out documents.
   2. Because of the constant product changes and approach, need to review with CCSD staff on the particular project. Request current equipment and component list from CCSD.
   3. Refer to Division 26 for conduit, boxes, sleeves, conduit support, etc. requirements.

D. SUMMARY – SECTION INCLUDES
   1. Access Control and Intrusion Detection

E. ACCESS CONTROL AND INTRUSION DETECTION
   1. Requirements for access control and intrusion detection system
      a. Submittal
      b. Access control and intrusion detection shall follow current structured cabling section 27 10 00. Preferred access control integrator is Paladin Technologies, Inc. (PTI). It is expected that PTI will provide all hardware associated with the access control and intrusion detection systems, however conduits, back boxes, and cabling are expected to be included in the scope of the general contractor. The district has standardized on Honeywell DMP XR series panels for IDS installations and the Pro 4200 for ACP solutions for access control and intrusion detection systems. The engineer/consultant shall provide design for the pathways for these systems based on coordination with CCSD and these vendors.

c. Each door with access control shall consist of a card reader, electric lock (strike/ hardware), and door contact, and be integrated with the ADA operator when applicable. A 3/4 inch conduit routed from the back box of each access control device to a consolidation box above each door and in case the door hardware is an electrified crash bar, the manufacturer to provide a remote above ceiling power supply to meet the need of power required for the lock device, this may be used as the consolidation box. From the consolidation box a 1 inch conduit shall run to the telecom room which PTI designates as the room designated as the room to house the access control panel and power supply. It is anticipated that card readers be located at the main building entry/exit as well as the kitchen entry/exit. Additional locations may be required around the perimeter depending on playground equipment locations, after care usage, and other considerations. In addition, there are some interior doors that require card readers which include all telecom rooms. Additional interior and exterior locations coordinated with CCSD Security and IST during design. All exterior door locations shall have a door contacts. Motion sensors located throughout the space. Typically located near each entry/exit as well as main corridors and stairwells. CCSD Security and IST will provide final locations during design.
d. These systems are wired in a loop configuration. Consultant/engineer to coordinate with CCSD for location of devices. It shall be the contractor's responsibility to provide a 16/4 bus cable in a loop configuration around the interior perimeter of the building, one each floor. Both ends of the loop shall terminate in a telecom room designated by Integrated Systems. A 22/2 wire shall be provided from each motion detector and door contact to the buss loop. An 22/2, 22/6, 18/4, and 22/4 composite cable shall be home run by the contractor from each door that has a card reader running from the consolidation box back to the access control panel location. In addition, the main entry and service entry locations require an 18-4 cable pulled with the door package wire and a single gang backbox in the entry vestibule for the purpose of being the local arming station for the building intercom. These locations will require a Category 6 cable and 18-4 cable to the location of the ACP headend. An 18-4 cable to the main officer reception desk to permit for remote release of the interior main entry, as well office door (if installed).
e. Sequence of actions as follows. The IDS panel will be armed by the ACP via relay logic and disarmed by any valid card read to gain entry to the building. The IDS panel remote armed/disarmed is from Winpak software at dispatch. Only keypad on site is installed at the headend location.
f. Door contacts on the IDS system are used as status point monitoring involved with the local LED visual annunciator. The purpose of this device to provide at a glance verification that the building is secure, all doors must be shut. Annunciator model is H. R. Kirkland Company, RSE-L-GR-GP3.
g. Integration of the ADA operator as follows. The unsecured side button should not be active until a valid card read, then button can be pressed and the operator will open the door. From the secured side of the door, when the ADA button is pressed, unlock the door, and then operator will open the door. Intention of this design is to prevent unnecessary wear/abuse to the ADA hardware, and door frame/door.
h. Buildings require auxiliary alarm components provided by Integrated Systems that include based on the systems and building. The components shall be tied into the access control system and provide by Integrated Systems, unless noted otherwise. All devices adjusted by the type of systems in the building or site. Coordinate with the design team and CCSD Facilities. All wiring in 3/4 inch conduits.
    1. Monitor phase monitor at each electrical service (Time Mark phase monitor provided by the electrical distribution system and monitored by access control system)

2. Environmental items
    i. Boiler low temperature alarm strap on aquastat installed on the return piping of the boiler (Honeywell/Resideo L6006C1018)
    ii. Boiler room wall with probe drilled through wall with Air Shunt device on the same alarm point as the boiler low temperature alarm (Air Shunt 2E399A)
    iii. Low temperature sensor on the ceiling per floor on the northwest corner of the building (Pottor RTS or Winland Electronics, Inc. TA-40)
    iv. Water sensors near floor drains in unfinished areas and boiler rooms (Winland Electronics, Inc. Waterbug 200)
    v. High water level sensors in sumps and lift station basins (monitor control panel alarm point)

i. Refer to responsibility matrix below

MATRIX OF CONSTRUCTION RESPONSIBILITIES

THE RESPONSIBILITIES LISTED HEREIN ARE PROVIDED AS A RECOMMENDATION AND DO NOT SUPERSEDE OR REPLACE ANY CONTRACTS, OR OTHERWISE DEFINED RESPONSIBILITIES, BETWEEN THE DESIGNATED PARTIES. IN ADDITION, THE INFORMATION IS MEANT TO INDICATE GENERAL RESPONSIBILITY FOR A SCOPE OF WORK AND IN NO WAY DISALLOWS THE RESPONSIBLE PARTY TO SUBCONTRACT THE SCOPE.

RESPONSIBLE PARTY	GENERAL CONTRACTOR		ELECTRICAL CONTRACTOR		TELECOM CONTRACTOR		LOW VOLTAGE CONTRACTOR		AUDIO-VIDEO CONTRACTOR		SECURITY CONTRACTOR		OWNER		NOTES
SCOPE OF WORK	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	FURNISH	INSTALL	
BUDGET OF WORK	CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		CONSTRUCTION		FIX-FURN-EQUIP		
SITE															
INCOMING SERVICE PROVIDER CABLING & COORDINATION													X	X	1
EXTERIOR CONDUIT PATHWAY / DUCTBANK			X	X											
INTERIOR INFRASTRUCTURE															
GROUNDING & BONDING			X	X	X	X									3, 4
INTERIOR CONDUIT PATHWAY			X	X											
BACKBOX / JUNCTION BOX			X	X											
FLOOR BOX / POKE THROUGH			X	X		X									5
CABLE TRAY			X	X											
J-HOOK / SLING					X	X									
SLEEVE / CONDUIT PENETRATIONS			X	X	X	X									6, 7
TELECOMMUNICATIONS															
PLYWOOD BACKBOARD	X	X													
LADDER RACK / LADDER RUNWAY / ACCESSORIES					X	X									
RACK / FRAME / CABINET (TELECOM)					X	X									
WIREMANAGER					X	X									
FIBER PATCH PANEL					X	X									
COPPER PATCH PANEL					X	X									
POWER DISTRIBUTION UNIT (PDU)					X	X									
UNINTERRUPTIBLE POWER SUPLY (UPS)					X	X									
MISCELLANEOUS RACK COMPONENTS (DRAWER, SHELF, ETC.)					X	X									
BACKBONE CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
HORIZONTAL CABLING SYSTEM (NETWORK, VOICE, CATV)					X	X									
FACEPLATE / JACK / SURFACE MOUNT BOX					X	X									
PATCH CABLE (INTERIOR TO TELECOMMUNICATIONS ROOM)					X									X	
PATCH CABLE (END DEVICE / OUTLET)					X	X		X		X		X		X	2
LABELING					X	X									
MEDIA CONVERTERS / COPPER EXTENDERS FOR NETWORK CABLING					X	X									
WIRELESS ACCESS POINT (WAP)						X							X		
BUILDING NETWORK (LAN) EQUIPMENT (SWITCH, HEADEND, ETC.)													X	X	9
PERIPHERAL EQUIPMENT (PHONE, PRINTER, PC, ETC.)													X	X	
LOW VOLTAGE (LV)															
PAGING / PUBLIC ADDRESS							X	X							
CELLULAR DISTRIBUTED ANTENNA SYSTEM (DAS)	X	X													
BUILDING NETWORK (LAN) CABLING TO LV SYSTEM(S)					X	X									
AUDIO VISUAL (AV)															
RACK / FRAME / CABINET (AV)									X	X					
AMPLIFIER / CONTROLLER / PROCESSOR / MATRIX									X	X					
MICROPHONE									X	X					
FACEPLATE / JACK									X	X					
CABLING (NON-NETWORK)									X	X					
SPEAKER									X	X					
DISPLAY & MOUNT									X	X					
DISPLAY BACKING	X	X													
PROJECTOR									X	X					
PROJECTOR SCREEN									X	X					
AUDIO VIDEO NETWORK EQUIPMENT (SWITCHES AND CABLING)									X	X					9
BUILDING NETWORK (LAN) CABLING TO AUDIO VIDEO SYSTEM(S)					X	X									9
SECURITY - ACCESS CONTROL SYSTEM (ACS)															
ACS HEADEND / CONTROLLER / PANEL											X	X			
ACS SOFTWARE, PROGRAMMING, & INTEGRATION											X	X	X	X	
CARD READER / KEYPAD AND LICENSE (AUTHENTICATION DEVICE)											X	X			
REQUEST TO EXIT (WHEN NOT INTEGRAL TO DOOR HARDWARE)											X	X			
INTERCOM & INTERCOM MASTER STATION											X	X			
DOOR POSITION SWITCH											X	X			
DOOR RELEASE BUTTON											X	X			
DOOR HARDWARE / COMPONENTS	X	X													
BUILDING NETWORK (LAN) CABLING TO ACS					X	X									9
SECURITY - VIDEO SURVIELLANCE SYSTEM (VSS)															
VSS NETWORK VIDEO RECORDER (NVR)													X	X	
VSS SOFTWARE, PROGRAMMING, & INTEGRATION													X	X	
CAMERA AND LICENSE											X	X			
BUILDING NETWORK (LAN) CABLING TO VSS					X	X									9
SECURITY - INTRUSION DETECTION SYSTEM (IDS)															
ID HEADEND / CONTROLLER / PANEL											X	X			
ID SOFTWARE, PROGRAMMING, & INTEGRATION											X	X			
MOTION SENSOR &/OR GLASS BREAK SENSORS											X	X			
LOCK-DOWN BUTTON											X	X			
PANIC / DURESS BUTTON											X	X			
AUTO-DIALER & DIAL DESTINATION COORDINATION											X	X			
BUILDING NETWORK (LAN) CABLING TO IDS					X	X									9

NOTES:

1. CONTRACTOR SHALL COORDINATE WITH OWNER REGARDING TIMELINE OF INSTALLATION AND REQUIREMENTS FOR INSTALLATION TO ENSURE A TIMLEY INSTALLATION.
2. THE PARTY RESPONSIBLE FOR INSTALLING THE END DEVICE (PC, CAMERA, WAP, ETC.) SHALL BE RESPONSIBLE FOR INSTALLING THE END-OF-RUN PATCH CABLE. AFTER INSTALLATION, VERIFICATION OF OPERABILITY IS REQUIRED.
3. THE ELECTRICAL CONTRACTOR SHALL i) EXTEND THE BUILDING GROUND TO EACH TELECOMMUNICATION SPACE ii) PROVIDE AND INSTALL THE BUSBAR(S), GROUNDING CABLES, AND ASSOCIATED EQUIPMENT, iii) AND ENSURE EACH TELECOMMUNICATION SPACE HAS PROPER ACCESS TO BUILDING GROUND THROUGH THE LOCAL BUSBAR AS SHOWN IN THE DRAWINGS.
4. FOR ALL DEVICES, EQUIPMENT, PATHWAY, AND OTHER SUCH MATERIAL REQUIRED TO BE GROUNDED, THE CONTRACTOR/PARTY, WITH WHICH THE DEVICE, EQUIPMENT, PATHWAY OR OTHER SUCH MATERIAL WAS INSTALLED BY, SHALL BE RESPONSIBLE FOR ITS PROPER BONDING AND GROUNDING.
5. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION AND INSTALLATION OF ALL FLOOR BOXES AND POKE THROUGHS, AS WELL AS ALL CONDUIT/PATHWAY REQUIREMENTS PERTAINING TO IT, REGARDLESS IF THERE IS POWER CABLING INCLUDED AT DEVICE. THE TELECOM CONTRACTOR SHALL COORDINATE WITH DRAWINGS AND ELECTRICAL CONTRACTOR TO ENSURE LOW VOLTAGE INFRASTRUCTURE AND CABLING REQUIREMENTS ARE MET AND SHALL PROVIDE AND INSTALL ALL CABLING AND FACEPLATE/TERMINATION EQUIPMENT PERTAINING TO DEVICE.
6. FOR ALL PENETRATIONS SHOWN IN DRAWINGS, THE ELECTRICAL CONTRACTOR SHALL PROVIDE AND INSTALL. THE ELECTRICAL CONTRACTOR SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE.
7. ALL PENETRATIONS NOT SHOWN ON DRAWINGS, BUT REQUIRED FOR CABLING INSTALLATION, SHALL BE PROVIDED AND INSTALLED BY THE CABLING INSTALLATION CONTRACTOR/TEAM. FOR FIRE-RATED PENETRATIONS, THE CABLE INSTALLATION CONTRACTOR/TEAM SHALL ENSURE THE EXTERIOR OF EACH PENETRATION IS FIRE-RATED TO MATCH OR EXCEED THE PENETRATED SURFACE. AFTER ALL CABLING IS INSTALLED, TESTED, AND ACCEPTED, THE INTERIOR OF EACH PENETRATION SHALL BE FIRE-RATED TO MATCH OR EXCEED THE PENETRATED MATERIAL.
8. IT IS ACCEPTABLE FOR THE CONTRACTOR TO REUSE AN EXISTING DEVICE WITH OWNER APPROVAL. COORDINATE WITH OWNER PRIOR TO ANY NEW DEVICE PROCUREMENT TO RECORD ALL DEVICES THAT MAY BE REUSED. FOR ALL DEVICES SCHEDULED FOR REUSE THAT REPLACE AN ITEM SCHEDULED FOR NEW, A CREDIT SHALL BE GIVEN TO OWNER FOR ITEM REPLACEMENT.
9. THE BUILDING NETWORK IS THE LOCAL AREA NETWORK (LAN) OF THE BUILDING AND CONNECTS DIRECTLY TO THE INCOMING SERVICE PROVIDER; IT PROVIDES GENERAL ACCESS TO THE WIDE AREA NETWORK (WAN). OTHER SYSTEMS MAY UTILIZE NETWORK EQUIPMENT TO SUPPORT THEIR SPECIFIC NEEDS, HOWEVER, THIS EQUIPMENT IS SEPARATE AND DISTINCT FROM THE BUILDING NETWORK (LAN) AND ASSOCIATED

END OF SECTION

DIVISION 31
EARTH WORK

SECTION #	SECTION NAME	COMMENTS/CHANGES	DATE

312000 - EARTHWORK

PART 1 – GENERAL

A. Summary - Section includes:

1. Grading
2. Excavation/fill
3. Erosion and sediment control
4. Topsoil

B. Referenced Standards/Minimum Criteria:

1. Compaction standards per Geotechnical Report (standard proctor density, ASTM D698 or modified proctor density, ASTM C1557.)
2. Materials and operations under this Section shall be per the recommendations of a Geotechnical Engineer employed by the Owner who will place qualified personnel on the site during earthwork operations.

C. Submittals Required:

1. Soil samples per Geotechnical Engineer.
2. Reports of soil testing during construction to be distributed by the testing laboratory to the Owner, Architect, and Contractor.

D. Restrictions/Critical Criteria:

1. Balance, cut and fill to the extent possible without compromising maximum and minimum scope criteria. 4:1 maximum slope typical, 3:1 maximum slope only as approved by Owner.
2. It shall be the responsibility of the Contractor to take measures and furnish equipment and labor necessary to control the flow, drainage and accumulation of water as required to permit completion of the work under this Section to avoid damage to the work.
3. Contractor shall export and dispose of debris, organic matter and soil that does not meet the criteria of the Geotechnical Engineer.
4. Provide erosion and sediment control plan and supporting drainage data as required by the local jurisdiction.
5. Where sufficient existing topsoil exists on site, replace at a minimum depth of 4" in all areas to be landscaped after rough grading is completed.
6. Rock Excavation: Material capable of removal using the equivalent of D-10 caterpillar tractor with a hydraulic single tooth ripper is considered as normal excavation and no extra will be allowed
7. Rough grade shall be subject to verification by Owner-provided survey firm.

PART 2 – PRODUCTS

A. Materials are unrestricted provided they meet specification requirements of the geotechnical engineer.

316326 – DRILLED CONCRETE PIERS

PART 1 – GENERAL

A. Summary - Section includes:

1. Drilling, casing (if necessary) and dewatering (if necessary) of drilled pier holes.

B. Referenced Standards/Minimum Criteria:

1. Concrete per ACI 336.1. Slump tests per ASTM C143.

C. Submittals Required:

1. Quality Control Submittals: Geotechnical Engineer Daily Reports (Drilling Log), daily reports filed by the Geotechnical Engineer during drilling shall contain as a minimum the following information:

   a. Identification mark.
   b. Shaft diameter.
   c. Design bottom elevation.
   d. Actual bottom elevation.
   e. Top elevation.
   f. Overrun or under-run.
   g. Bearing strata description and condition of bearing strata.
   h. Length and location of casing used.
   i. Nature and location of obstructions.
   j. Water conditions during drilling and at time of concrete placement.
   k. Unusual occurrences during drilling, reinforcement, concrete placement or casing removal.

D. Restrictions/Critical Criteria:

1. Unit Prices: Bid proposals for piers shown on the drawings shall be on the basis of elevations given. If actual site conditions differ from those indicated by the soils investigation, the unit cost overrun and under-run figures indicated on the bid form will be applied to establish any extra due the Contractor or credit due the Owner due to changes in depths of piers. Unit prices for pier overruns shall not exceed under-runs by more than 20%.
2. Casings shall be available in sufficient length to case the entire depth of each pier hole if necessary. The use of mud slurry to lubricate casing or seal off water will be allowable only with the prior approval of the Geotechnical Engineer.
3. Reinforcing steel shall be full length of pier without splices. In reinforced piers, completed installation of concrete reinforcement must be approved by the Geotechnical Engineer before placement of concrete.
4. Allowable Tolerances: Accurately locate piers as shown on the plans. No pier shall deviate from its true location by more that 1-1/2" at the top nor shall it be out of plumb by more than 1-1/2% of its length.

PART 2 – PRODUCTS

A. Materials are unrestricted provided they meet specification requirements.

DIVISION 32
EXTERIOR IMPROVEMENTS

SECTION #	SECTION NAME	COMMENTS/CHANGES	DATE

321200 – ASPHALTIC PAVING

PART 1 – GENERAL

A. Summary - Section includes:
   1. Flexible pavement for parking areas and drives.
   2. Base for elementary play areas and runways for track and field events.

B. Referenced Standards/Minimum Criteria:
   1. Comply with Section 400 - Pavements, Section 700 - Bituminous Materials, Section 702 - Bituminous, and Section 703 - Aggregates, of the Colorado State Highway Department Standard Specifications, latest Edition.
   2. Testing of base course compaction and sampling of asphalt concrete mixtures for quality control during paving will be done by the testing laboratory (paid for by the Owner) using applicable ASTM and AASHTO testing procedures.

C. Submittals Required:
   1. Asphalt concrete mixes
   2. Pre-emergent
   3. Test reports

D. Restrictions/Critical Criteria:
   1. Immediately prior to application of aggregate base course or full depth asphalt, apply Pre-Emergent to subgrade.
   2. Second and third lifts must be placed within 48 hours of preceding lift or a tack coat will be required.
   3. Apply tack coat of emulsified asphalt to edge of curb and all other concrete surfaces adjoining asphalt paving.
   4. Permeable paving may be considered on a case by case basis by the owner where subgrade permeability is conducive and is acceptable to local jurisdictions.

PART 2 – PRODUCTS

A. Base course materials: Gravel base type and thickness per Geotechnical report.

B. Asphaltic concrete mixture: Grades S and SX as defined by Colorado State Highway Department Standard Specifications. Use Grade SX for top surface course and Grade S for all other fills. Only virgin materials shall be used in mixture, no reclaimed asphalt pavement (RAP) shall be allowed. Thickness of asphalt as per Geotechnical report. The School District prefers to use fill depth asphalt design sections but will consider including alternates for asphalt on base course design.

C. Reinforcing Mesh: Reinforcing mesh shall be designed for use under asphalt paving as required by Geotechnical report.

D. Pre-Emergent: Elanco Treflan Pre-Emergent or approved substitute.

321300 – CONCRETE PAVING, CURBS, GUTTERS, & SIDEWALKS

PART 1 – GENERAL

A. Summary - Section includes: Rigid concrete paving.
   1. Curbs and gutters.
   2. Sidewalks.
   3. Concrete curbs around gravel play areas.
   4. Concrete stairs.
   5. Concrete drainage swales.

B. Reference Standards/Minimum Criteria:
   1. Concrete work: ACI 301 and ACI 304R.
   2. Cold weather placement: ACI 306.
   3. Hot weather placement: ACI 605
   4. Concrete materials: Ready mixed concrete conforming to ASTM C94 and ASTM C1116. No on-job mixed concrete will be allowed. Slump tests by Contractor per ASTM C143.
   5. Expansion joints: ASTM D1751 or D1752.
   6. Reinforcing mesh: 6" x 6" x w2.9 x w2.9 conforming to ASTM A18S for vehicle paving and 6" x 6" x w1.4 x w1.4 for sidewalks. Fibrous reinforcing complying with ASTM C1116.
   7. Finish with Class B Tolerance. Finish shall be true planes within 1/4" in 10-ft. as determined by a 10-ft. straightedge placed anywhere on the slab in any direction. Use broom finish.
   8. Control tests by testing laboratory in accordance with ASTM C391, C138, and C231. Curing of test cylinders per ASTM C31 and C172.
   9. Local jurisdiction standards for public sidewalks, curbs, gutters, ramps, driveway approaches and aprons.

C. Submittals Required:
   1. Concrete mix designs.
   2. Test reports.
   3. Contractor's record listing time, date and temperature of concrete placement.

D. Restrictions/Critical Criteria:
   1. Environmental Requirements: When concrete has been placed in cold weather and the temperature may drop below 35° F, Contractor to provide insulated curing blankets, or other suitable materials. Concrete injured by frost action shall be removed and replaced at the Contractor's expense.
   2. Typical thickness of sidewalks is 4". Thickness of vehicle pavement per Geotechnical report.
   3. Score Joints: Maximum of 6 feet on center.
   4. Expansion Joints: Provide expansion joints thirty (30) feet maximum on center, between site concrete and building. Expansion joints shall extend through the entire slab with bituminous fiber expansion joint filler. Hold top of joint filler down or use removable zip-strip on top of filler at joints to allow for joint sealant.

5. Handicap Ramps: Ramps shall receive tactile warning surface texture in accordance with local jurisdiction Standards and Specifications. Provide pigmented concrete as required by local jurisdiction Standards.

PART 2 – PRODUCTS

A. Concrete paving is required at all curbs, gutters, sidewalks, and trash pickup areas/dumpster pads.

B. Concrete paving is preferred at bus traffic/parking areas, and service vehicle/loading dock areas.

C. Curing and anti-spalling compound is required for all exterior flatwork.

D. Curb configuration to be vertical with full cut at drives and ramps.

E. Fibrous mesh additive is required for exterior flatwork.

321313 – POST-TENSIONED CONCRETE TENNIS COURTS

PART 1 – GENERAL

A. Summary - Section includes:
   1. Post-tensioning materials.
   2. Post-tensioning operations.

B. Referenced Standards/Minimum Criteria:
   1. Post-tensioning strands and anchorages conform to "PTI Guide Specifications for Post-Tensioning Materials".

C. Submittals Required:
   1. Shop drawings to include:
      a. Cable layout with dimensions.
      b. Cable and sheathing profiles showing support chair heights. Indicate location and method of tendon support.
      c. Details of special reinforcement at cable anchorage points.
      d. Details, location, and arrangement of cable dead end and stressing end anchorage devices.
      e. Cable placing sequence and details.
      f. Jacking sequence and methods.
      g. Jacking force and jack pressure.
      h. Maximum temporary jacking force and jack pressure.
   2. Test Results and Certification:
      a. Mill tests (including typical stress-straw curve).
      b. Equipment calibration tests (including method of identification of stressing units and a curve relating jack forces to gauge readings).

D. Restrictions/Critical Criteria:
   1. Acceptable post-tensioned concrete tennis court contractors:

a. Southwest Recreational Industries, Inc.
b. Other contractors as pre-approved by the Owner.

2. Provide vapor barrier under slab and over excavation and structural fill under slab if recommended by Geotechnical Engineer.
3. Cables shall be placed no more than 2'-6" on center in each direction based on engineering design.
4. Provide keyed construction joints between each individual court and at net line of each court. No other joints are allowed. Contractor may opt to place concrete in one pour.
5. Concrete shall be placed in one continuous operation without joints with the exception of construction joints. Slab thickness shall be uniform four (4) inches utilizing a minimum sixty-(60) foot long continuous mechanical screed. Finish surface of concrete shall have no water-holding areas deeper than 1/8". Flood court surface to verify slope, drainage, and lack of ponding areas.
6. Contractor shall not apply tensioning force until the concrete has reached a minimum strength of 2,000 psi. Strength of concrete in place shall be determined according to ACI 301. Contractor may make additional cylinders at his expense to determine correct strength. Tensioning may begin one (1) week after the concrete has been verified to have achieved the minimum strength.
7. Each tendon may initially be tensioned to a maximum of eighty percent (80%) ultimate breaking strength and anchored at a minimum of seventy percent (70%) ultimate breaking strength.
8. The cable ends shall be cut off and cone holes shall be grouted flush with edge of slab.

PART 2 – PRODUCTS

A. Acceptable materials:
   1. Post-tensioning strands and anchorages shall conform to the "PTI Guide Specifications for Post-tensioning Materials".
   2. The tensioning strands shall consist of one-half inch (1/2") diameter, 7-wire, stress relieved strands, having a guaranteed ultimate tensile strength of 270,000 psi (270) Kips). Strands shall conform to ASTM-416. Cables shall be fabricated to proper length for each slab, coated with a permanent rust preventative lubricant and encased in slippage sheathing. All breaks in the sheathing shall be repaired with tape prior to concrete placement. A maximum of six inches (6") exposed strands is permitted at the dead-end anchor.
   3. The concrete shall have a compressive strength of not less than 3,500 psi after twenty-eight (28) days. Ready-mixed concrete shall be mixed and delivered according to ASTM C-94 specifications for ready-mixed concrete with a four inch (4") maximum slump. Mix design as follows: cement – type 1, six sack unit weight – 140.3 lbs. per cubic foot, air entrainment 6.0%, water/cement ratio – 0.52/1.

321723 – PAVEMENT MARKING

PART 1 – GENERAL

A. Summary - Section Includes:
   1. Layout and painting of lines.
   2. Direction arrows/signs in pavement.

B. Referenced Standards/Minimum Criteria:
   1. Thickness of paint to comply with Colorado State Highway Department specifications.

C. Submittals Required:
   1. None

D. Restrictions/Critical Criteria:
   1. Pavement marking shall not be done in wet weather or when the temperature is below 40 degrees F.
   2. Parking lot lines shall be 4" wide painted by mechanical striping machine.

PART 2 – PRODUCTS

A. Solvent base paint complying with Colorado State Highway Department specifications. White and blue colors.

B. Thermoplastic crosswalk, symbols, and other markings as directed by Owner. Thickness to be 90 mil.

321726 – SIGNAGE

PART 1 – GENERAL

A. Summary - Section includes:
   1. Traffic control signs and posts.

B. Referenced Standards/Minimum Criteria:
   1. Comply with requirements of all regulatory agencies having jurisdiction.
   2. Comply with applicable requirements of Americans with Disabilities Act, Accessibility Guidelines (ADAAG) and the International Building Code (IBC).

C. Submittals Required:
   1. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Verify type, location, and direction of sign face of signs with school district.
   2. Aluminum traffic control signs mounted on galvanized steel framing and 12 gauge galvanized square tube steel posts with perforations as required for attachment of signage to post. Set steel posts in square sleeving (next size up from steel post) in

concrete.

PART 2 – PRODUCTS

A. Acceptable Manufacturers
   1. Vulcan Signs, Inc.
   2. J & S Signs
   3. Colorado Barricade
   4. Midwest Barricade
   5. Signage, Inc.
   6. Scott Sign Systems, Inc.
   7. United Rentals
   8. Approved Substitute

321800 – SYNTHETIC TURF

PART 1 – GENERAL

A. Summary: The Turf Contractor shall supply and install the Owner selected synthetic turf system, suitable for football, soccer, field hockey and lacrosse. The Turf Contractor's installer must have installed a minimum of 5 fields using the infill system. Synthetic turf shall be a complete system including synthetic turf, granular aggregate base, sub-surface and perimeter drainage, and all necessary concrete edging as specified herein.

B. Referenced standards/minimum criteria:
   1. Permeability (to ASTM D4491): The system shall allow a minimum percolation rate of 5 inches per hour.
   2. Relative Abrasiveness (to ASTM F1015): The system has an Abrasiveness Index of 20.2.
   3. Shock Absorbency (to ASTM F355): G-Max range of 110-130 for duration of 8-year warranty.
   4. Flammability (to ASTM D2859): Pass
   5. RESTRICTIONS:

To ensure structural stability: $D60/D10>5$ and $1<\frac{D^2\ 30}{D10D60}<3$
Fragmentation must be 100%

To ensure separation of both stones: $\frac{D85\text{ of finishing stone}}{D15\text{ of base stone}}>2$
And $3<\frac{D50\text{ of base stone}}{D50\text{ of finishing stone}}<6$

To ensure proper drainage: Permeability of base stone >600 in/hr (0.42 cm/sec)
Permeability of finishing stone >150 in/hr (0.106 cm/sec)
Porosity of both stones >25%
(When stone is saturated and compacted to 95% Proctor.)

Depending on the type of rock present in the crushed stone mix, other mechanical characteristics might be necessary for approval.

"Dx" is the size of the sieve (in mm) that lets pass x% of the stone. For example, D60 is the size of the sieve that lets 60% of the stone pass. These sizes, for calculation purposes, may be obtained by interpolation on a semi-log graph of the sieve analysis.

6. Both the carpet and infill material shall meet all federal, state, and local environmental regulations.
7. EXISTING CONDITIONS:
   a. The Owner, through the General Contractor, shall satisfy himself as to the nature of the existing soil conditions on site, and shall be responsible for carrying out all tests necessary for the construction of the sports field base.
   b. The General Contractor shall carry out all grading work to sub-base level, and shall accept full responsibility for the suitability of this level. The Turf Contractor shall start his work on the existing sub-base.
8. WARRANTY:
   a. The Turf Contractor and the Manufacturer shall provide the Owner with a written warranty to guarantee the materials and installation for a period of eight (8) years from the date of acceptance against all defects in workmanship and materials and premature wear and tear, provided that the product is properly maintained and used per the Maintenance Manual, and for a period of eight (8) years from ultraviolet degradation due to normal exposure to the sun.
   b. Warranty shall include a yearly turf sweeping and repainting of all painted markings prior to each season: August for fall sports; March for spring sports.
9. MAINTENANCE: Turf Contractor shall supply Owner with a written maintenance manual for proper care of the finished product. The Maintenance Manual shall specify any use limitations for the fields (e.g. heavy vehicle traffic, etc.).

C. Submittals Required: With the Bid the proposing Turf Contractor must submit the following:
   1. Synthetic Turf – One (1) sample – approximately 7" x 11".
   2. Knitted in 4" white line.
   3. Manufacturer's data certifying compliance with these specifications.
   4. Certified list of existing installations, including Owner representative and telephone number, attesting compliance with quality assurance information.
   5. Sieve analysis of the proposed base rock.

   Prior to installation the Turf Contractor must submit the following for review and approval:
   6. Field drainage system design layout with pipe sizing and spacing.
   7. Color coded shop drawing layout of all inlaid and painted lines, numbers, and logo locations corroborated with the latest National Federation of State High School Associations (FNSHSA) standards and requirements.
   8. Contractor shall provide all required documentation to the Owner that all SBR rubber used on this project is Colorado Certified Recycled Rubber (from Colorado tires). Documentation shall be in accordance with the Colorado Waste Tire Recycling Grant Program Guidelines. For more information go to

www.dola.coloardo.gov/waste_tire.

PART 2 – PRODUCTS

A. SYNTHETIC TURF
1. General: Permeable infilled synthetic grass that provides the look, the feel, and playability of natural grass with respect to ball speed and bounce and maximum safety to the athletes.
2. The entire system shall be resistant to weather, insects, rot, mildew, fungus growth and it is non-toxic.
3. The surface shall provide superior traction in all types of weather with the use of conventional athletic shoes and composition molded-soles. Long cleats are not required and should not be used.
4. The infill materials shall be selected to provide the shock attenuation characteristics of the System. The System shall maintain a G-Max reading as described in ASTM F1936-98 ***Shock Absorbing Properties of North American Football Field Playing Systems*** as measured in the field.
5. Field Markings:
   a. Field of play football and soccer perimeter lines, yardage numbers, logos and 5-yard lines shall be tufted in (in-laid). Other markings (hash marks, 1 yard lines, field hockey, and all lacrosse lines) shall be painted on after the insertion of the infill.
   b. Only paint approved by the Manufacturer is permitted to be used on the turf.
   c. Install lines and markings for the following sports: Football, soccer, field hockey and lacrosse for both boys and girls where applicable.
6. Carpet Fiber: A low friction blended polyethylene fiber, nominal 2-2 ½" long poly fiber tufted into a permeable double-layered primary backing with a secondary backing. The tufts shall be fanned (or unfolded) at installation. It shall have the following properties:

Property	Units	ASTM
Pile Yarn Type:	UV-resistant poly	
Yarn Denier:	8000 nominal	D1577
Yarn Breaking Strength:	Min. 1.2gms/denier	D2256
Yarn Melting Point:	250 degree F	D789
Minimum Pile Height	2 inches	D418
Maximum Pile Height	2 ½ inches	D418
Pile Weight	42 oz/sq. yd.	D418
Machine Gauge	¾ inch centers max.	D418
Tuft Bind (without infill)	6 lbs.	D1335
Grab Tear Strength	170 lbs.	D1682
Pill Burn Test Pass		D2859
Permeability	10-40 inches/hour	D4491

   a. Primary backing: shall be UV-treated woven polypropylene, weighing approximately 8 oz/sq yd.
   b. Secondary backing: shall be a permeable application of high quality latex or polyurethane, heat activated to lock the fiber tufts into the primary backing materials.

c. Base Bid shall be fibrillating fiber. Monofilament fiber option shall be included as an alternate bid.

7. Infill: Consists of ground rubber, or a blend of graded dust free sand as approved by the Manufacturer, and ground rubber as approved by the Manufacturer.
8. Approved Manufacturers: The Owner shall have the option of selecting one product line meeting the specifications above from one of the following manufacturers.
   a. Sportexe
   b. Challenger Industries
   c. Desso
   d. Fieldturf
   e. Others as approved by Owner
9. Approved Installers:
   a. Academy Turf
   b. Hellas Construction
   c. American Civil Constructors
   d. Others as approved by Owner

B. BASE MATERIAL: The Base shall be constructed of crushed stone aggregate per Manufacturer' specifications. The base layer shall be a minimum of 4" at the crown, topped by a finishing layer with a maximum of 2" of finer crushed stone. The final decision on the thickness of the Base layer will be dictated by the permeability of the selected Base stone, the rainfall Intensity-Duration-Frequency (IDF) data for the site location, and the stability and load-bearing capacity of the sub-base. The Turf Contractor shall provide a sieve analysis of the proposed base for approval by Owner's Representative. Recycled concrete may be substituted as approved by Owner.

C. DRAIN PIPE: The collector drainage pipes shall be rigid PVC plastic wall smooth bore pipe, laid with a minimum slope of 0.3%. The individual field drain shall be 12" Enka Turf Drain material. The Turf Contractor shall carry the collector pipe to its exit outside the field per the drawings. The trench in which the pipe is set shall be filled with permeable granular material, ½" or ¾" drain rock or any similar free draining material as approved by the Owner's Representative.

D. EDGING: The edging around the fields shall be concrete per the details on the drawings.

321823 - TENNIS COURT SURFACING

PART 1 – GENERAL

A. Summary - Section includes:
   1. Tennis court surfacing.
   2. Tennis court boundary lines.

B. Reference Standards/Minimum Criteria:
   1. Installer shall specialize in tennis court surfacing and shall be approved by

system manufacturer.

C. Submittals Required:
   1. Product data.
   2. Color samples of surfacing and striping paint.

D. Restrictions/Critical Criteria:
   1. Two (2) year warrantee for materials and installation.
   2. Do not apply surfacing during rainfall or when rainfall is imminent. Do not apply surfacing unless the air temperature is at least 50 degrees F. for a 24hour period of time during and following application.
   3. Line Marking: Apply marking conforming to the specifications of the United States Tennis Court and Track Builders Association

PART 2 – PRODUCTS

A. Acceptable tennis court surfacing systems:
   1. TPS Coatings, Inc.
   2. Nova Sports USA
   3. Elite Systems
   4. or approved equal

B. Primer
   1. The prime coat shall be as specified by the color acrylic manufacturer.

C. Leveling Course(s)
   1. Only acrylic based patching compounds are to be used.

D. Acrylic Resurfacer
   1. Acrylic resurfacer coats shall consist of the following components:
      acrylic resurfacer
      silica sand, #30
      Sufficient water to make a workable mixture (fresh and potable)
   2. Mixture shall be as specified by the color acrylic manufacturer.

E. Acrylic Color
   1. The acrylic color applications will consist of one (2) applications the following:
      undiluted acrylic color
      water (fresh and potable)
      silica sand (30 mesh)
   2. Mixture shall be as specified by the color acrylic manufacturer.
   3. The mixture shall provide not less than 115 gallons of color concentrate per court. (This quantity is before water or any fillers are added.) This provision will be strictly enforced and monitored.
   4. Color Selection: To be selected by Owner

F. Playing Lines
   1. Playing lines shall be painted on using white, latex acrylic, line paint.

321824 - BASEBALL FIELD SURFACING

PART 1 – GENERAL

A. Summary - Section includes:
   1. Baseball field infield.
   2. Skinned softball field.
   3. Other unseeded surfaces inside baseball and softball fenced areas.

B. Referenced Standards/Minimum Criteria:
   1. None.

C. Submittals Required:
   1. Require contractor to submit sieve analysis and plasticity index of proposed surface mix and pitcher's mound mix before ordering.
   2. Require contractor to submit 1 pound sample in plastic bag of each mixture.

D. Restrictions/Critical Criteria:
   1. Elevation and size of pitcher's mound per Colorado State High School standards.
   2. Remove debris and rocks larger than ½" from area to be surfaced.
   3. Surface to be a minimum of 4" deep.

PART 2 – PRODUCTS

A. Surfacing Mix for Infields:
   1. 70% fine fill sand.
   2. 30% fine fill clay.
   3. submittal required

B. Surfacing Mix for Pitchers Mound:
   1. 60% fine fill sand.
   2. 40% fine fill clay.

C. Surfacing Mix for Warning Tracks:
   3. Granite Crusher Fines (breeze) 3/8" minus sieve

321825 - RUNNING TRACK SURFACING

PART 1 – GENERAL

A. Summary - Section includes:
   1. Running track.
   2. Field event runways and pads.
   3. Line markings for track.

B. Reference Standards/Minimum Criteria:
   1. Installer shall specialize in track surfacing and shall be approved by system manufacturer.

2. The work shall be done in a thorough, workmanlike manner by member contractors of the United States Tennis Court & Track Builders Association. Contractor shall have a Certified Track Builder on staff, and shall conform to the USTC & TBA's standards for track construction.
3. The track surface will be applied by a licensed firm, which has been installing the material for the past five years. Contractor references for five similar, successfully executed projects will be required.

C. Submittals Required:
1. Product data.
2. Samples of surfacing.

D. Restrictions/Critical Criteria:
1. Three (3) year warrantee for materials and installation for latex tracks.
2. Five (5) year warrantee for materials and installation for urethane tracks.
3. The work shall be done in a thorough, workmanlike manner by member contractors of the United States Tennis Court & Track Builders Association. Contractor shall have a Certified Track Builder on staff, and shall conform to the USTC & TBA's standards for track construction.
4. The track surface will be applied by a licensed firm, which has been installing the material for the past five years. Contractor references for five similar, successfully executed projects will be required.
5. Do not apply surfacing during rainfall or when rainfall is imminent. Do not apply surfacing unless the air temperature is at least 50 degrees F. for a 24hour period of time during and following application.
6. Prior to proceeding with surfacing system, flood test asphalt substrate in the presence of the Architect to assure positive drainage as designed and to determine if track has depressions holding water. Flood test with a minimum of a 2" hose attached to an irrigation quick coupler.
7. Line Marking: Apply marking conforming to the specifications of the National Federation of State High Schools Association.
8. Contractor shall provide all required documentation to the Owner that all SBR rubber used on this project is Colorado Certified Recycled Rubber (from Colorado tires). Documentation shall be in accordance with the Colorado Waste Tire Recycling Grant Program Guidelines. For more information go to www.dola.colorado.gov/waste_tire

PART 2- PRODUCTS

A. Acceptable track surfacing installers:
1. Renner Sport Surfaces, Inc.
2. Hellas Construction
3. Fisher Tracks
4. Vibra-Whirl
5. General Acrylics
6. others as pre-approved by Owner

B. Acceptable latex systems for running tracks/runways/pads (use latex binders for middle schools).

1. Primer: SBR latex binder produced by Unocal or Dow Chemical for use in running tracks or approved equal. The latex binder shall have a minimum solids content of 50% per drum.
2. Black Rubber Base Mat Granule (non-stranded): Manufacturer's specified Styrene Butadiene Rubber (SBR). Maximum size range shall be 1-3mm uniformly graded and containing less than 4% dust - with no trace of fiber or steel. All SBR rubber shall be Colorado Certified Recycled Rubber (from Colorado tires).
3. Latex Binder: A fortified SBR or acrylic latex binder produced by a reputable manufacturer of such products used in the construction of running tracks. The fortified latex binder shall have a minimum solids content of at least 50% per drum. Asphaltic emulsion binders are not acceptable. Latex binder shall be pigmented black in the final spray layers.
4. Completed resilient latex surface shall have a minimum thickness of 3/8".

C. Acceptable urethane systems for running tracks/runways/pads (use polyurethane binders for High Schools):
1. Primers: Polyurethane-based primers, specially formulated to be compatible with the base and track surfacing materials.
2. Rubber (SBR): The basemat rubber shall be specifically graded Styrene Butadiene Rubber (SBR). Final gradation is to be 1.0-3.0 mm granulated SBR containing less than 4% dust - with no trace of fiber or steel. SBR is to be dried to no less than 2.5% moisture and sealed in bags. All SBR rubber shall be Colorado Certified Recycled Rubber (from Colorado tires).
3. Black Rubber (EPDM): The wearing course of rubber shall be synthetic colored EPDM, the same color as the liquid polyurethane binder. Final graduation is to be .5mm-1.5mm. Specific gravity is to be 1.53+.02.
4. Basemat Binder: The basemat shall be bound by moisture-cured liquid polyurethane, compatible with the base mat rubber. No asphaltic emulsions or epoxies are allowed in the base mat.
5. Structural Spray layers: The black EPDM rubber is to be bound by two coats of spray applied material. Polyurethane is to be moisture-cured, single component, elastomeric polyurethane, applied in a net quantity of 3.8 lbs. per sq. yd. Color to be black.
6. Total thickness of the installed system shall average 13mm in thickness.

D. Paint for all track lines and markings shall be Sherwin Williams Metalatex water based acrylic enamel or approved equal. Paint shall not be diluted. Paint shall be delivered to jobsite in new, unopened containers.

323113 - CHAIN LINK FENCES/BACKSTOPS

PART 1 – GENERAL

A. Summary - Section includes:
1. Fencing around tennis courts to include gates.
2. Site perimeter fencing to include gates.
3. Baseball backstops.
4. Softball backstops.

5. Shot-put backstops.
6. Exterior utility equipment enclosures.
7. Interior chain link partitions.

B. Reference Standards/Minimum Criteria:
   1. Chain link fabric and pipe frame material shall comply with standards and specifications of the Chain Link Fence Manufacturers Institute.
   2. All steel, including fabric, pipe, and fittings shall be first quality, full weight, hot-dipped galvanized materials in accordance with ASTM F1083. All weights and dimensions are nominal. Exterior chain link fencing components and material receiving thermally fused and adhered polyvinyl chloride (PVC) coating, minimum 10 mils thick, over galvanized surface shall be in accordance with ASTM F668, Class 2B. Movable and threaded fittings need not be factory coated but field coated per manufacturer's recommendations.

C. Submittals Required:
   1. Shop drawings.

D. Restrictions/Critical Criteria:
   1. Verify with Owner locations where PVC coatings will be required.
   2. Enclosure Top: Provide removable chain link top for exterior utility enclosures of same materials as sides as required by utility company.
   3. Gate posts/Swing gates:

Minimum Gate Post Sizes	Gate Width	
Size	Single	Double
2-3/8" o.d	Under 4'	N/A
2-7/8" o.d.	N/A	Up to 12'

   All gate hardware to be heavy duty, galvanized with lockable latches.
   4. Top and bottom selvage of the fabric shall be knuckled.
   5. Set all line posts in concrete.
   6. Top rails for fences and bottom/center rails for tennis court fencing and baseball/softball backstops shall be as nearly parallel to finish grade as possible.
   7. Posts and rails at backstops shall be welded, and top and bottom rails shall be continuous. The center rail of tennis court fencing shall be welded with face of rail flush with fabric side of line posts.
   8. All backstop rails shall be welded to posts.
   9. Fabric shall be placed on players side of posts for backstops and tennis court fencing.
   10. Space line posts for fences not more than 10' feet apart.
   11. Provide 12" wide x 4" thick concrete mow bands along fence line adjacent to irrigated turf.

PART 2 – PRODUCTS

A. Fabric: No. 9 gauge wire (No. 6 gauge at lower tier of backstops), galvanized and vinyl coated, woven into 2" chain link mesh (1-3/4" mesh at tennis court). Zinc coating by weight will not be less than 1.2 ounces per square foot. Wire used in fabric shall be open hearth steel, containing not less than 0.20% copper with a tensile strength of not less than 85,000 lb. per square inch.

B. Line Posts: 2-3/8" o.d. up to 6' ht., 2 -7/8" over 6' ht. (2-7/8" o.d. at tennis court and 2-7/8", 4", & 6" o.d. at backstops depending on height), schedule 40 pipe.

C. Line Post Tops: Heavy galvanized, cast-iron eye-top fittings to be set over post snugly.

D. Top, Center and Bottom Rails: Schedule 40 pipe, 1-5/8" o.d. weighing 2.27 lb. per foot, provided with 7" long expansion sleeve couplings.

E. Fabric Ties: No. 11 gauge galvanized steel tie wire shall be used to tie fabric to framework. Ties to tension wire shall be made with heavy galvanized hog rings or wire.

F. Tension Wire: Two strands of 12 gauge galvanized spiral tension wire with attaching fittings.

G. Terminal Post Tops: End and corner posts to be fitted with heavy galvanized cast iron tops of bullet-type construction.

H. Terminal Posts: Schedule 40 pipe. End, corner, and pull posts 2-7/8" o.d. pipe, weighing 5.79 lb. per foot up to 6' height, 4" o.d. over 6' height.

I. Brace Panel Assembly: All end and gate posts shall be braced with 1-5/8" o.d. Schedule 40 pipe weighing 2.27 lb. per foot, and adjustable 3/8" galvanized truss rod with malleable iron truss tighteners. Corner posts shall be furnished with two complete brace panels assemblies.

J. Tension Bands: Beveled edge type with either nuts and bolts or special lockpin type.

K. Footings shall be concrete.

323129 – ROUGH SAWN CEDAR WOOD FENCE

PART 1 – GENERAL

A. Summary - Standards includes:
   1. Wood fencing and post footings.

B. Referenced Standards/Minimum Criteria:
   1. Wood materials shall comply with standards and specifications of the International Fence Industry Association.

C. Submittals Required:
   1. None.

D. Restrictions/Critical Criteria:
   1. Line and terminal Posts: Space line posts as required by length of rails.
   2. Rails: Set rails as nearly parallel to the finish grade as possible and at the

specified height of fence. In the case of sloping grades, the rails shall be sloped uniformly parallel to the finish grade as nearly as possible and in a manner to prevent any abrupt changes in grade of the rails.

PART 2 - PRODUCTS

A. Line Posts: Approximately 6" x 6" rough sawn cedar. 4 sided, 45 degree chamfer 1" down from top all around.

B. Rails: Shall be 2" x 8" rough sawn cedar, 8' or 10' long. Use 3 rails at play areas, 2 rails in all other locations.

C. Fastenings: Shall be galvanized 3/8" x 3 ½" long lag though bolts with washers. 2 per rail at post, countersink nut and washer, head flush at rail.

D. Footings shall be concrete, 6" all around, 3' deep.

E. Provide 18" wide x 4" thick concrete mow bands along fence line adjacent to irrigated turf.

323300 - ATHLETIC AND RECREATION EQUIPMENT

PART 1 – GENERAL

A. Summary - Section includes:
   1. Tennis court wind screen fabric.
   2. Tennis court nets and posts.
   3. Combination soccer/football goal posts.
   4. Soccer goals.
   5. Baseball field team benches.
   6. Football and soccer field corner markers.
   7. Field event equipment.

B. Referenced Standards/Minimum Criteria:
   1. Owner review per site/project

C. Submittals Required:
   1. Product Data

D. Restrictions/Critical Criteria:
   1. Install all items per manufacturer's recommendations.

PART 2 – PRODUCTS

A. Acceptable manufacturers/products.
   1. Combination Soccer/Football Goal Posts: Porter or approved equal.
   2. Tennis Court Nets and Posts: Porter or approved substitute.
   3. Shot-Put Toe Board: Gill Athletics or approved substitute.

4. Tennis Court Wind Screen: Open mesh shade screen or approved substitute, 6 ft. high 7 oz. Open mesh polyester with brass grommets 12" o.c., along all four sides. Provide hog rings and poly rope for attachment.
5. Soccer Goals: Porter or approved substitute.
6. Pole Vault Plant Pit: Gill Athletics or approved substitute.
7. Baseball Field Team Benches: Stationary aluminum bench, no back with stationary legs.
8. Field Corner markers: Standard surveying markers.
9. Others as approved by Owner.

324000 - SITE FURNISHINGS

PART 1 – GENERAL

A. Summary - Section includes:
   1. Plastic coated steel benches.
   2. Plastic coated trash receptacles.

B. Referenced Standards/Minimum Criteria:
   1. Owner review per project/site.

C. Submittals Required:
   1. Product data
   2. Color options

D. Restrictions/Critical Criteria: Install per manufacturer's recommendations.

PART 2 – PRODUCTS

A. Acceptable manufacturers:
   1. Owner approved list

325000 - GRAVEL PLAY AREAS

PART 1 – GENERAL

A. Summary - Section includes:
   1. Concrete curb at perimeter of play areas.
   2. Pea gravel fill (by School District)
   3. Play equipment (by School District)
   4. Drainage of play areas

B. Referenced Standards/Minimum Criteria:
   1. Refer to Sections 02513 and 03300 for concrete requirements.
   2. Refer to Section 02710 subdrainage systems for products to be used to drain play areas.

C. Submittals Required:
   1. Product data

D. Restrictions/Critical Criteria:
   1. The perimeter of all gravel play areas to have 6" wide x 2-'0" deep reinforced concrete curb. Top edges of curb to have 2" radius (omit radius where curb abuts concrete sidewalk or asphalt play area).
   2. Subgrade in play box shall be 14" below top of curb.
   3. Slope grades at bottom of play areas a minimum of 1% and maximum of 2% toward perforated drainage pipe that runs the full length of the play area. Perforated pipe to be set in minimum of 12" x 12" trench in bottom of play area. Trench to be filled with 3/4" washed gravel with minimum of 2" below the perforated pipe. Pipe size and daylight connection to be determined by Civil Engineer. Perforated pipe shall include filter fabric sock.
   4. Pea gravel and play structures to be installed by School District separately from this work.

PART 2 – PRODUCTS

A. Acceptable products:
   1. Filter fabric sock around perforated drainage pipe with 3/4" washed gravel gravel trench.

328400 - IRRIGATION SYSTEM

PART 1 – GENERAL

A. Summary-Section includes:
   1. Static pressure verification and coordination of irrigation system installation with landscape material installation.
   2. Trenching, stockpiling excavation materials, refilling and compacting trenches.
   3. Complete irrigation system including but not limited to piping, booster pump (when required), backflow preventer assemblies, valves, fittings, heads, controllers and wiring, and final adjustments to insure complete coverage.
   4. Water connections.

B. Referenced Standards (Minimum Criteria):
   1. American Society for Testing and Materials (ASTM)-Specifications and Test Methods specifically referenced in this Section.
   2. Underwriters Laboratories (UL) - UL Wires and Cables.
   3. Installer Qualifications-Installer shall have had considerable experience and demonstrate ability in the installations of irrigation system(s) of specific type(s) in a neat orderly, and responsible manner in accordance with recognized standards of workmanship. To demonstrate ability and experience necessary for this Project, and financial stability, submit if requested by Consultant, prior to contract award the following:
      a. List of 3 projects completed in the last 2 years of similar complexity to this Project. Description of projects shall include:

- Name of project.
- Location.
- Owner.
- Brief description of work and project budget.

b. Current company financial statement.

4. Special Requirements:
   a. Work involving substantial plumbing for installation of copper piping, backflow preventer(s), and related Work shall be executed by licensed and bonded plumber(s).
      Secure a permit at least 48 hours prior to start of installation.
   b. Tolerances: Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, compaction, and repair of finish grade treatment.
   c. Coordination With Other Contractors: Protect, maintain, and coordinate Work with Work under other Sections.
   d. Damage To Other Improvements: Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Sections during Work associated with installation of irrigation system at no additional cost to Owner.
   e. Irrigation operation: Contractor shall conform to all local water district standards and restrictions. Additional irrigation permits and variances required by the project shall be obtained by contractor and paid by owner.
5. Pre-construction Conference: Contractor shall schedule and conduct a conference to review in detail quality control and construction requirements for equipment, materials, and systems used to perform the Work. Conference shall be scheduled not less than 10 days prior to commencement of Work. All parties required to be in attendance shall be notified no later than 7 days prior to date of conference. Contractor shall notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to Owner, Architect, Consultant, Contractor's Superintendent, and Installer.
6. Landscape Plan Review and Coordination: Contractor will be held responsible for coordination between landscape and irrigation system installation. Landscape material locations shown on the Landscape Plan shall take precedence over the irrigation system equipment locations. If irrigation equipment is installed in conflict with the landscape material locations shown on the Landscape Plan, the Contractor will be required to relocate the irrigation equipment, as necessary, at Contractor's expense.
7. Static Pressure Verification: Contractor shall field verify the static pressure at the project site, prior to commencing work or ordering irrigation materials, and submit findings, in writing, to Consultant. If Contractor fails to verify static water pressure prior to commencing work or ordering irrigation materials, Contractor shall assume responsibility for all costs required to make system operational and the costs required to replace any damaged landscape material. Damage shall include all required material costs, design costs and plant replacement costs.

C. Submittals Required:
   1. Shop Drawings.
   2. Record Drawings (As-Builts):

At onset of irrigation installation secure cad files of original irrigation design from Owner. At the end of every day, revise prints for Work accomplished that day in red ink. As-built field records shall be brought up-to-date at the close of the working day every Friday by a qualified draftsperson. A print of record plan(s) shall be available at Project Site. Indicate zoning changes on weekly as-built drawings. Indicate non-pressure piping changes on as-builts. Upon completion of Project, submit for review, prior to final acceptance, final set of as-built mylar sepias. Dimensions, from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures), location of following items:

a. Connection to existing water lines.
b. Routing of sprinkler pressure lines (dimension maximum 100 feet along routing).
c. Sprinkler control valves.
d. Quick coupling valves.
e. Drain valves.
f. Drip line blow-out stubs.
g. Control wire routing if not with pressure mainline.
h. All gate valves.
i. Drip line blow-out stubs.
j. Other related equipment as directed.

3. Operation Instructions: Submit 3 written operation instructions including winterization procedures and start-up, with cut sheets of products, and coordinate controller/watering operation instructions with Owner maintenance personnel. Include the following controller charts:
   a. Do not prepare charts until record (as-built) drawings have been reviewed by Consultant.
   b. Provide one controller chart for each automatic controller installed.
      •Chart may be reproduction of record drawing, if scale permits filling of controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
      •Chart shall be print of actual "as-built" system, showing area covered by that controller.
      •Chart does not require lateral pipe sizing to be visible to maintain clarity at reduced size.
   c. Identify area of coverage of each remote control valve, using a distinctly different pastel color drawing over entire area of coverage.
   d. Following review of charts by Consultant, they shall be hermetically sealed between two layers of 20 mm thick plastic sheet.
   e. Charts shall be completed and reviewed prior to final review of irrigation system.
4. Warranty/Guaranty: Manufacturer shall warrant materials against defects for a period of one year from date of Substantial Completion. Installer(s) shall guarantee workmanship for similar period.
   a. Settling of backfilled trenches which may occur during guaranty period shall be repaired at no expense to owner, including complete restoration of damaged property.
   b. Expenses due to vandalism before substantial completion shall be borne by Contractor.
   c. Owner will conduct normal maintenance operations during warranty period, so

as not to hamper proper operation of irrigation system.

5. Maintenance:
   a. Furnish the following maintenance items to Owner prior to final Acceptance:
      - 2 Sets of special tools required for removing, disassembling, and adjusting each type of sprinkler head and valve supplied on the Project.
      - Two 6 foot valve keys for operation of gate valves or stop and waste valves. (if applicable).
      - 2 Keys for each automatic controller.
      - 4 Quick coupler keys and 4 matching hose swivels for each type of quick coupling valve installed.
      - 2 aluminum drain valve keys of sufficient length for operation of each type of drain valve.
   b. Winterization: include cost in bid for winterizing complete system at conclusion of sprinkling season (in which system received final acceptance) within 3 days notification by the Owner. System shall be voided of water using compressed air or similar method reviewed by Consultant. Reopen, operate, and adjust system malfunctions accordingly during April of following season within 3 days of notification by Owner.
6. Extra Stock: In addition to installed system, furnish the following items to Owner for each School:
   a. 10 Pop-up spray heads with nozzles of each type used.
   b. 4 Rotor heads of each type used.
   c. 30 Drip emitters or one 100' roll of inline emitter of each type used.

D. Restrictions/Critical Criteria:
1. Inspection: Examine areas and conditions under which Work of this Section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.
   a. Underground Utilities shall be installed prior to installation of irrigation system. If irrigation installation takes place prior to utility installation, Contractor shall notify Owner of this condition in writing prior to commencement of irrigation installation.
   b. Contractor is responsible to notify Consultant of any field conditions that vary from the conditions shown on the Irrigation Construction Documents. If Contractor fails to notify Consultant of these conditions, Contractor will be held responsible for all costs associated with the system adjustments required due to the change in field conditions.
2. Protection of Property:
   a. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to Work of this Section. In the event damage does occur, all items shall be completely repaired or replaced to satisfaction of Owner. All cost of such repairs shall be charged to and paid by Contractor.
   b. Protect buildings, walks, walls, and other property from damage. Flare and barricade open ditches. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at not cost to Owner. Restore disturbed areas to original condition.
3. Existing Trees:
   a. All trenching or other Work under limb spread of any and all evergreens or low branching deciduous material shall be done by hand or by other methods so

as to prevent damage to limbs or branches.

b. Where it is necessary to excavate adjacent to existing trees use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2 inch and larger roots occur, shall be done by hand. Roots 2 inches or larger in diameter, except directly in the path of pipe of conduit, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Where a trenching machine is operated close to trees having roots smaller than 2 inches in diameter, wall of trench adjacent to tree shall be hand trimmed, making clean cuts through roots. Trenches adjacent to trees shall be closed within 24 hours, and when this is not possible, side of trench adjacent to tree shall be kept shaded with moistened burlap or canvas.

4. Protection and Repair of Underground Lines:
   a. Request proper utility company to stake exact location (including depth) of all underground electric, gas, or telephone lines. Take whatever precautions are necessary to protect these underground lines from damage. If damage does occur, all damage shall be repaired by Utility Owner. All cost of such repairs shall be paid by Contractor unless other arrangements have been made.
   b. Request Owner, in writing, to locate all private utilities (i.e., electrical service to outside lighting) before proceeding with excavation. If, after such request and necessary staking, private utilities which were not staked are encountered and damaged by Installer, they shall be repaired by Owner at no cost to Installer. If Contractor damages staked or located utilities, they shall be repaired by Utility Owner at Contractor's expense unless other arrangements have been made.
5. Replacement of Paving and Curbs: Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and shall be restored to original condition.
6. All grading, with the exception of final grading, shall be completed and approved by Owner before staking or installation of any irrigation system begins.
7. Staking shall Occur as Follows:
   a. Mark, with powdered lime, routing of pressure supply line and flag heads for first few zones. Contact Consultant 48 hours in advance and request review of staking. Consultant will advise installer as to the amount of staking to be prepared. Consultant will review staking and direct changes if required. Review does not relieve installer from coverage problems due to improper placement of heads after staking.
   b. If Project has significant topography, freeform planting beds, or other amenities which could require alteration of irrigation equipment layout as deemed necessary by Consultant. Do not install irrigation equipment in these areas until Consultant has reviewed equipment staking.
8. Install sleeving under asphalt paving and concrete walks prior to concreting and paving operations, to accommodate piping and wiring. Compact backfill around sleeves per geotechnical engineer's recommendations.
9. Trenching: Trench excavation shall follow, as much as possible, layout shown on Drawing. Dig trenches straight and support pipe continuously on bottom of trench. Trench bottom shall be clean and smooth with all rock and organic debris removed. Trench per the following criteria:
   a. Clearances:
      - Piping 3 Inches and Larger - Make trenches of sufficient width (14 inches

minimum) to properly assemble and position pipe in trench. Minimum clearance of piping 3 inches or larger shall be 5 inches horizontally on both sides of the trench.

- Piping Smaller than 3 Inches - Trenches shall have a minimum width of 7 inches.
- Line Clearance - Provide not less than 6 inches of clearance between each line, and not less than 12 inches of clearance between lines of other trades.

b. Pipe and Wire Depth:
   - Pressure Supply Piping - 24inches from top of pipe.
   - PVC Sleeving - 24 inches from top of pipe.
   - Non-pressure Piping (rotor) - 18 inches from top of pipe.
   - Non-pressure Piping (pop-up) - 12 inches from top of pipe.
   - Control Wiring - Side of pressure main.
   - Drip tubing - As detailed for application.

c. Boring will be permitted only where pipe must pass under obstruction(s) which cannot be removed. In backfilling bore, final density of backfill shall match that of surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through sleeves. Observe same precautions as though pipe were installed in open trench.

10. PVC Piping: Snake pipe in trench as much as possible to allow for expansion and contractions. Do not install pipe when air temperature is below 40°F. Place manual drain valves at low points and dead ends of pressure supply piping to insure complete drainage of system. When pipe laying is not in progress, or at end of each day, close pipe ends with tight plug or cap. Perform Work in accordance with good practices prevailing in piping trades.
    a. Solvent Weld PVC Pipe: Lay pipe and make all plastic to plastic joints in accordance with manufacturer's recommendations.
    b. Gasketed End Pipes:
       - Lay pipe and make pipe to fitting or pipe to pipe joint, following OR70 recommendations (John-Manville Guide for Installation of Ring-Tite Pipe), or pipe manufacturer's recommendations.
       - Construct thrust blocks behind all pressure main fittings, tees, bends, reducers, line valves, and caps in accordance with pipe manufacturer's recommendations. Contact Consultant prior to placing thrust blocks, for observation of thrust block excavation and initial placement. Consultant to size thrust blocks based on standard engineering practices.
11. Control Wiring:
    a. Low Voltage Wiring:
       - Bury control wiring between controller and electric valves in pressure supply line trenches, strung as close as possible to main pipe lines with such wires to be consistently located below and to one side of pipe.
       - Bundle all 24 volt wires at 10 foot intervals and lay with pressure supply line pipe to one side of the trench.
       - Provide an expansion loop at every pressure pipe angle fitting, every electric control valve location (in valve box), and every 500 feet. Form expansion loop by wrapping wire at least 8 times around a 3/4 inch pipe and withdrawing pipe.

- Make all splices and E.C.V. connections using 3M-DBY connectors or similar dry splice method.
- Install all control wire splices not occurring at control valve in a separate splice valve box.
- Install one control wire for each control valve.
- Run two spare #14 A.W.G. U.F.U.L. control wires and one common wire from controller pedestal to the end of each and every leg of mainline. Label spare wires at controller and wire stub box.

b. High Voltage Wiring for Automatic Controller:
- Provide 120 volt power connection to automatic controller.
- All electric work shall conform to local codes, ordinances, and authorities having jurisdiction. All high voltage electrical work shall be performed by licensed electrician.

12. Automatic Controller:
    a. Install controller in accordance with manufacturer's instructions as detailed and where shown on Drawings. Verify location with owner prior to installation.
    b. Connect remote control valves to controller in numerical sequence as shown on Drawings.
    c. Final location of controller shall be approved by Consultant prior to installation.
    d. Each controller shall have a dedicated separate ground wire, grounding rod and/or plate as detailed.
    e. All above ground conduit shall be rigid galvanized or UV rated schedule 80 electrical conduit with appropriate fittings. All below ground conduit shall be schedule 80 electrical conduit.
13. Electric Control Valves: Install cross-handle 6 inches below finished grade where shown on Drawings as detailed. When grouped together, allow at least 12 inches between valve box sides. Install each remote control valve in a separate valve box. Install individual valve box flush with grade. Maintain proper clearances between box and pipe. Valve box shall not rest on pipe or altered (cut) to obtain relief.
14. Quick Coupling Valves: Install quick couplers on double swing-joint assemblies of Schedule 80 PVC pipe; plumb and flush to grade. Angled nipple relative to pressure supply line shall be no more than 45 degrees and no less than 10 degrees. Install quick coupling valves as detailed.
15. Drip Valve Assemblies: Install drip valve assembly as detailed.
16. Drip Emitters: Stake all surface emitters as detailed and staked with acceptable tubing stakes.
17. Drain Valves: Install manual drain valves at all low points in pressure supply lines. Provide a three cubic foot drainage sump for each drain valve installed.
18. Valve Boxes:
    a. Install one valve box for each type of valve installed as detailed.
    b. Install gravel sump after compaction of all trenches. Place final portion of gravel inside valve box after valve box is backfilled and compacted.
    c. Brand controller letter and station number on lid of each valve box. Letter and number size shall be no smaller than 1 inch and no greater in size than 1 ½ inches. Depth of branding shall be no more than 1/8 inch into valve box lid.
19. Sprinkler Heads: Spacing of heads shall not exceed the maximum recommended by manufacturer. Install heads on double swing-joint risers of Marlex PVC pipe.

Angled nipple relative to non-pressure line shall be no more than 45 degrees or less than 10 degrees. Swing joint to consist of 3 Marlex Street Ells and one 10 inch schedule 80 nipple. Adjust part circle heads for proper coverage. Adjust heads to correct height after sod is installed. Plant placement shall not interfere with intended sprinkler head coverage, piping, or other equipment. Consultant may request nozzle changes or adjustments without additional cost to the Owner.

20. Backfilling: Do not begin backfilling operations until required system tests have been completed. Consultant and/or Owner shall observe all joints of pressure pipe prior to backfill. Backfill shall not be done in freezing weather except with review by Consultant. Leave trenches slightly mounded to allow for settlement after backfilling is completed. Trenches shall be finish graded prior to walk-through of system by Consultant.
    a. Materials: Excavated material is generally considered satisfactory for backfill purposes. Backfill material shall be free of rubbish, vegetable matter, frozen materials, and stones larger than 1 inch in maximum dimension. Do not mix subsoil with topsoil. Material not suitable for backfill shall be hauled away. Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable or not sufficient to meet backfill, compaction, and final grade requirements.
    b. Do not leave trenches open for a period of more than 48 hours. Open excavations shall be protected in accordance with OSHA regulations.
    c. Compact backfill per geotechnical recommendations.
21. Piping Under Paving:
    a. Provide for a minimum cover of 18 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete or concrete paving.
    b. Piping located under areas where asphalt or concrete paving will be installed shall be bedded with sand (a layer 6" below pipe and 6" above pipe).
    c. Compact backfill material in 6" lifts per geotechnical engineer's recommendations.
    d. Set in place, cap, and pressure test all piping under paving, in presence of Owner prior to backfilling and paving operations.
    e. Piping under existing walks or concrete pavement shall be done by jacking, boring, or hydraulic driving, but where cutting or breaking of walks and/or concrete is necessary, it shall be done and replaced at not cost to Owner. Obtain permission to cut or break walks and/or concrete from Owner.
22. Flushing: After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves, thoroughly flush piping system under full head of water pressure from dead end fittings. Maintain flushing for 5 minutes through furthermost valves. Cap risers after flushing.
23. Testing: Conduct mainline pressure test in presence of Consultant. Arrange for presence of Consultant/Owner 48 hours in advance of testing. Supply force pump and all other test equipment.
    a. After backfilling, and installation of all control valves, fill pressure supply line with water, and pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater, for a period of 2 hours.
    b. Leakage, Pressure Loss - Test is acceptable if no loss of pressure is evident during the test period.

c. Leaks - Detect and repair leaks.
d. Retest system until test pressure can be maintained for duration of test.
e. Before final acceptance, pressure supply line shall remain under pressure for a period of 48 hours.

24. Walk-Through for Substantial Completion:
    a. Arrange for Consultant's presence 48 hours in advance of walk-through.
    b. Entire system shall be completely installed and operational prior to scheduling of walk-through.
    c. Operate each zone in its entirety for Consultant at time of walk-through and additionally, open all valve boxes if directed.
    d. Generate a list of items to be corrected prior to Final Completion.
    e. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.
    f. During walk-through, expose all drip emitters under operations for observation by Consultant to demonstrate that they are performing and installed as designed, prior to placing of all mulch material. Schedule separate walk-through if necessary.
25. Walk-Through for Final Completion:
    a. Arrange for Consultant's presence 48 hours in advance of walk-through.
    b. Show evidence to Consultant that Owner has received all accessories, charts, record drawings, and equipment as required before Final Completion walk-through is scheduled.
    c. Operate each zone, in its entirety for Consultant at time of walk-through to insure correction of all incomplete items.
    d. Items deemed not acceptable by Consultant shall be reworked to complete satisfaction of Consultant.
    e. If, after request of Consultant for walk-through for Final Completion of irrigation system, Consultant finds items during walk-through which have not been properly adjusted, reworked, or replaced as indicated on list of incomplete items from previous walk-through, Contractor shall be charged for all subsequent walk-throughs. Funds will be withheld from final payment and/or retainage to Contractor, in amount equal to additional time and expenses required by Consultant to conduct and document further walk-through's as deemed necessary to insure compliance with Contract Documents.
    f. Submit Maxi-dollar receipts for all Rain Bird installed equipment prior to final acceptance.
26. Adjusting: Upon completion of installation, "fine-tune" entire system by regulating valves, adjusting patterns and break-up arms, and setting pressure reducing valves at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure ± 7%.
    a. If it is determined that irrigation adjustments will provide proper coverage, and improved water distribution as determined by Consultant, contractor shall make such adjustments prior to Final Acceptance, as directed, at no additional cost to Owner. Adjustments may also include changes in nozzle sized, degrees of arc, and control valve throttling.
    b. All sprinkler heads shall be set perpendicular to finish grade unless otherwise

designated.

c. Areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at no additional cost to the Owner.

27. Water Source shall be from potable domestic service unless Grey Water is available in the vicinity.

PART 2 – PRODUCTS

A. ACCEPTABLE MATERIALS:

1. General Piping:
   a. Pressure Supply Line (from point of connection through backflow prevention unit) - Type "k" Hard Copper.
   b. Pressure Supply Lines (downstream of backflow prevention units) - Class 200 PVC BE (1" - 2 ½") and Class 160 PVC RT (3" and larger).
   c. Non-pressure Lines - Class 200 PVC BE.
   d. PVC Sleeving - Class 160 PVC.
   e. Drip Tubing - Toro Dura-Pol EHD 1645 3/4" with .050 inch wall thickness.
   f. Emitter Tubing - As recommended by emitter manufacturer.
2. Copper Pipe and Fittings:
   a. Copper Pipe - Type K, hard tempered.
   b. Fittings - Wrought copper, solder joint type.
   c. Joints - Soldered with solder, 45% silver, 15% copper, 16% zinc, and 24% cadmium and solidus at 1125°F and liquids at 1145°F.
3. Brass Pipe and Fittings:
   a. Brass Pipe - 85% red brass, ANSI Schedule 40 screwed pipe.
   b. Fittings - Medium brass, screwed 125 pound class.
4. Plastic Pipe and Fittings:
   a. Identification Markings:
      - Identify all pipe with following indelible markings:
        - Manufacturer's name.
        - Nominal pipe size.
        - Schedule of class.
        - Pressure rating.
        - NSF (National Sanitation Foundation) seal of approval.
        - Date of extrusion.
   b. Solvent Weld Pipe: Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 AND ASTM 1784; cell classification 12454-B, Type 1, Grade 1.
      - Fittings: Standard weight, Schedule 40, injection molder PVC; complying with ASTM D1784 and D2466, cell classification 12454-B.
        - Threads: Injection molded type (where required).
        - Tees and ells: Side gated.
      - Threaded Nipples - ASTM D2464, Schedule 80 with molded threads.
      - Joint cement and Primer - Type as recommended by manufacturer of pipe and fittings.
   c. Gasketed End Pipe: Manufactured from virgin Polyvinyl Chloride compound in accordance with ASTM D2241 and ASTM D1784; cell classification 1254-B, Type 1, Grade 1.

- Fittings (3" and larger): Ductile iron, grade 70-55-05 in accordance with ASTM F - 477.
- Gaskets: Factory installed in pipe and fittings, having a metal or plastic support within gasket or a plastic retainer ring for gasket.
- Lubricant: As recommended by manufacturer of pipe fittings.

d. Flexible Plastic Pipe - Manufactured from virgin polyethylene in accordance with ASTM D2239, with a hydrostatic design stress of 630 psi and designated as PE 2306.
- Fittings – Insert type manufactured in accordance with ASTM D2609; PVC Type 1 cell classification 12454-B.
- Clamps - All stainless steel clamps or manufacturer recommended fastener.

5. Gate Valves:
   a. Gate Valves for 3/4 inch through 2-1-1/2 Inch Pipe - Brass construction, solid wedge, IPS threads, and non-rising stem with wheel operating handle.
   b. Gate Valves for 3 Inch and Larger Pipe - Iron body, resilient wedge AWWA gate valves with a clear waterway equal to full nominal diameter of valve; rubber gasket or mechanical joint-type only. Valves shall be able to withstand a continuous working pressure of 150 psi and be equipped with a square operating nut.
6. Quick Coupling Valves: Brass two-piece body designed for working pressure of 125 PSI; operable with quick coupler. Equip quick coupler with locking rubber cover. Key size and type as shown on Drawing.
7. Valve Boxes:
   a. Gate Valves and Wire Stub Box: Carson #910-12 or approved equal box as detailed.
   b. 3/4 inch through 2 inch Control Valves: Carson #1220-12 or approved equal box as detailed.
8. Electrical Control Wiring:
   a. Low Voltage:
      - Electrical Control Wire: AWG UFUL approved No. 14 direct burial copper wire or larger, if required to operate system as designed.
      - Wire Colors:
        - Control Wires - Red.
        - Common Wires - White.
        - Master Valve Wires - Blue.
        - Spare Control Wires - Black.
        - Spare Common Wires - Yellow.
      - If multiple controllers are utilized, and wire paths of different controllers cross each other, both common and control wires from each controller shall be different colors approved by Consultant.
      - Control Wire connections and splices shall be made with 3M direct bury dry splice connectors, or similar dry splice method.
   b. High Voltage: Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.
9. Automatic Controller: Rain Bird, ESP, SAT, Size and type as required.
10. Electric Control Valves: Rain Bird Brass Construction, size and type as required having manual flow adjustment (except drip valves) and manual bleed nut.
11. Sprinkler Heads: Rain Bird with riser nipples of same size as riser opening in sprinkler

body.

12. Backflow Preventer: Febco size and type as required, Brass construction with 150 psi working pressure.
13. Booster Pump: Size and type as required. Variable Frequency Drive unless owner deems not required for application. Verify manufacturer with Owner.
14. Maxicom Central Control System: Rain Bird with the following features:
    a. Stainless Steel Enclosure (with dedicated phone line connection extended from building to inside enclosure).
        - Flow Sensing Ability.
        - CCU (6 channel or 28 channel based on size of site).
        - Surge Protection.
    b. Master Valve normally closed.
    c. Grounding Grid.
    d. Rainguage.
15. Drip Irrigation Systems:
    a. Drip Tubing - Manufactured of flexible vinyl chloride compound conforming to ASTM D1248, Type 1, Class C, Category 4, P14 and ASTM D3350 for PE 122111C.
    b. Fittings - Type and diameter recommended by tubing manufacturer.
    c. Drip Valve Assembly - Type and size shown on Drawings.
        - Wye Strainer – Plastic construction with 150 mesh nylon screen and 1/2 inch blowout assembly.
        - Control Valve - 2 way, solenoid pilot operated type made of synthetic, non corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal; retained (mounted) without attachment to diaphragm.
        - Pressure Reducing Valve - Plastic construction as detailed.
    d. Emitters - Single port, pressure compensating, press on type.
    e. In-line Emitters - Single port, pressure compensating.

329200 - LANDSCAPING

NOTE: THIS SECTION COMBINES AND SUPERCEDES:
02921 - FINE GRADING AND SOIL PREPARATION
02933 - SEEDING
02935 – SODDING
02950 - TREES, SHRUBS & GROUND COVER

PART 1 - GENERAL

A. Summary - this Section includes the following:
    1. Trees.
    2. Shrubs.
    3. Ground covers.
    4. Soil Preparation and Amendments.
    5. Fertilizers and mulches.
    6. Stakes and guys.
    7. Landscape edging.

B. Submittals

1. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
2. Delivery tickets for all bulk materials with Owner's Representative's approval or acknowledgment that materials were received in satisfactory condition.
3. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
4. Manufacturer's certified analysis for standard products, where applicable.
5. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
6. Label data and cut sheets substantiating that landscape materials, including all soil amendments, herbicides, and pesticides, comply with specified requirements.
7. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
8. Certification of each seed mixture for sod, identifying sod source, including name and telephone number of supplier.

C. Samples of each of the following:
   1. One cubic foot of fir fiber mulch and rock mulch in labeled plastic bags, boxes, or buckets.
      a. Edging materials and accessories.
      b. Weed Barrier.
      c. Soil amendments.
      d. Staking and guying materials.
      e. All items requested by Contractor for Substitution or as an Approved Equal.
   2. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
   3. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.
      a. Analysis of existing surface soil for planting suitability.
      b. Analysis of imported soil amendment for planting suitability.
   4. Planting schedule indicating anticipated dates and locations for each type of planting.
   5. Three (3) sets maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

   6. Three (3) copies of a written warranty stating all items included in the warranty, conditions of the warranty, and beginning and ending of warranty period(s).

D. Quality Assurance
   1. Installer Qualifications: Engage an experienced installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
   3. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect's satisfaction, based on evaluation of agency-

submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

4. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z 60.1 "American Standard for Nursery Stock:, and all applicable state and local rules and regulations.
5. Inspection: Landscape Architect may inspect plants either at place of growth or at site before planting, for compliance with requirements for name, variety, size and quality. Notify the Landscape Architect at least 5 working days in advance.
6. The Landscape Architect reserves the right to reject at any time or place prior to final acceptance all plant materials which in the Landscape Architect's opinion fail to meet specifications. Inspection of materials is primarily for quality, size, and variety, but other requirements are not waived even though visual inspection results in approval. Plants may be inspected where available; however, inspection at the places of supply shall not preclude the right of rejection at the site or at a later time prior to final acceptance. Rejected material shall be removed from the site within 24 hours.
7. The Contractor shall schedule inspection of the plants, at either the supplier or on site, to be completed in one visit. Any further inspection required due to plants being unavailable or rejected as not meeting specifications shall be charged to the Contractor at the current hourly rate for Landscape Architect's personnel performing the inspection.
8. Topsoil Analysis: The Contractor shall furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay and sand), deleterious material, pH, salts, and mineral and plant-nutrient content of topsoil.
9. Report suitability of existing topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil.
10. Measurements: Measure trees and shrubs according to ANSI Z 60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100 mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
11. Pre-installation Conference: Contractor shall attend pre-installation conference at locations specified by Owner's Representative.
12. U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act: Quality Standards for Certified Seed.

E. Delivery, Storage and Handling

1. Packaging Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at site. The Landscape Architect reserves the right to inspect containers before or after installation to verify compliance with Specifications.
2. Seed: Deliver seed in original sealed, labeled, and undamaged containers. The Landscape Architect reserves the right to inspect containers before or after installation to verify compliance with Specification
3. Sod: Harvest, deliver, store and handle sod according to the requirements of the American Sod Producers Association's (ASPA) "Specifications for Turfgrass Sod Materials and Transplanting/Installing". Protect sod from drying and breaking.
4. Trees and Shrubs: Deliver nursery stocked or freshly dug trees and shrubs. Do not prune before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping and other handling and typing

damage. Do not bend or bind-tie trees and shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Plant materials delivered without protective covering may be rejected. Do not drop trees and shrubs during delivery. Label at least one (1) tree and one (1) shrub of each variety with a securely attached waterproof tag bearing a legible plant name. Remove all tags and flagging as directed by Landscape Architect.

5. Handle balled and burlapped stock by the root ball.
6. Deliver trees, shrubs, ground covers and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist. Provide delivery notification to Owner's Representative at least 5 working days in advance.
7. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
    a. Do not remove container-grown stock from containers before time of planting.
    b. Water root systems of trees and shrubs stored on site with a fine mist spray.
    c. Water as often as necessary to maintain root systems in a moist condition.

F. Project Conditions
1. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned. Contractor shall be responsible for utility locating, repair of utilities damaged by Contractor, and establishment of grade controls.
2. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.
3. Clearing and Grubbing: Applies to all contract work areas which have vegetation or weed growth of 2 inch height or greater, and which are designated to be topsoiled, amended, seeded, sodded and/or planted under this Contract.

G. Coordination and Scheduling
1. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.
2. Seeding shall be restricted according to the following schedule unless otherwise approved by Owner:
    a. Below 6000' elevation: Spring seeding shall occur between spring thaws to June 15th. Fall seeding shall occur between September 1st until consistent ground freeze.
    b. Spring thaw shall be defined as the earliest date in a calendar year in which seed can be buried ½ inch into the topsoil thru normal drill seeding methods.
    c. Consistent ground freeze shall be defined as that time during fall months in which the topsoil, due to freeze conditions, prevents burying seed ½ inch thru normal drill seeding operations.
3. Do not lay sod on frozen ground or during months when the irrigation system is shut down. Do not lay sod during summer restriction periods of local jurisdictions. Obtain all necessary sodding and watering permits before installation.
4. Plant trees and shrubs after final grades have been accepted and prior to planting turf and native grasses, unless authorized by Owner's Representative.
5. Contractor shall stake locations of all trees for review by the Owner's Representative prior to planting. Make all adjustments to locations as directed by the Owner's Representative.

H. Warranty
   1. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
   2. Special Warranty: Warrant the following living planting materials for a period of one (1) year after date of Final Acceptance, against defects including death and unsatisfactory growth, except for defects resulting form lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.
      a. Trees.
      b. Shrubs.
      c. Seeded Areas.
      d. Sodded Areas.
   3. Replace planting materials that are excessively pruned, more than 25 percent dead, or in an unhealthy or declining condition immediately upon notice from the Owner's Representative. The Contractor shall prune all plants that have less than 25% dead branches at the end of the Warranty Period.
   4. All plants shall be true to name and meet all conditions of these specifications. Any plant which is not true to name as indicated by form, leaf, flower or fruiting characteristics shall be replaced at the Contractor's expense.
   5. Seeded areas shall be accepted on the basis of having uniform grass growth over all the seeded areas. Acceptable uniform grass growth shall be defined as when scattered bare spots, not greater than one square foot, do not exceed 5% of the seeded area.
   6. Inadequate or improper maintenance by the Owner shall not be cause for replacement, provided the Contractor shall have submitted a letter or report to the Owner on improper or inadequate maintenance practices and recommended remedial actions.
   7. The warranty shall not be enforced should any plant die due to vandalism after Final Acceptance.
   8. At the end of the warranty period the Contractor shall remove all stakes and guy materials and trim dead branches from all trees. Depending on time of year the Contractor shall also remove tree wrapping.

I. Tree, Shrub, Ground Cover and Plant Maintenance
   1. Maintain trees, shrubs, ground covers and plants by pruning, cultivating, watering, winter watering, weeding, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damage tree wrappings. Maintain trees and shrubs for the following period:
      a. Maintenance Period: Through plant warranty period.

J. Sod Turf Grass Maintenance
   1. Begin maintenance of sodded turf grasses immediately after each area is planted and continue until acceptable turf is established, but for not less than the following period:
      a. Maintenance Period: Until Final Acceptance.
      b. Contractor shall provide a minimum of two (2) mowings of sodded areas during the Maintenance Period.
      c. Contractor shall not allow sodded grass height to exceed 5" before mowing. Do not remove more than 2" per mowing. Rake and remove clippings that accumulate in dense masses.

2. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade and replant bare or eroded areas and remulch to produce a uniformly smooth turf.

K. Native Grass and Turf Seed Maintenance
   1. Maintain irrigated native grass and turf seeded areas by weeding, watering, re-grading, reseeding, and mulching as required to insure erosion control and complete seed coverage. Begin maintenance of grasses immediately after each area is planted and continue maintenance for not less than the following periods:
      a. Maintenance Period: 90 days following Substantial Completion of all landscape work or until a healthy, uniform stand of grass is established. See H. Warranty, 5. for basis of acceptability. (Contingent upon Owner acceptance, irrigated seeded areas will be turned over to the Owner for maintenance).
      b. Contractor shall provide a minimum of one (1) mowing of irrigated native grass and turf seeded areas during the Maintenance Period.
      c. Weeding during the Maintenance Period shall be by herbicide method approved in advance by the Owners Representative. Do not apply herbicide while grass seed is in germination period or when rain is expected within 24 hours. Schedule irrigation system with timing of herbicide application to avoid wash off. Do not allow weeds to develop to maturity with woody stems. Schedule herbicide application prior to mowing. Do not mow until herbicide has taken effect.
      d. Where feasible and if required by local jurisdictions seeded areas without permanent irrigation may be manually watered during the maintenance period from quick couplers on the irrigation system. The Owner shall approve manual watering on a project by project basis.

L. Restrictions/Critical Criteria
   1. Planting Soil Preparation
      a. Clean topsoil of roots, plants, sod, stones, lumps and other material harmful to plant growth and the appearance of a smooth finish grade.
      b. Mechanically rip or till amendments into existing subsoil at a minimum depth of 6".
      c. Spread amendments and fertilizers at rates indicated:
      d. Mechanically and evenly spread amendments in all areas to be sodded and seeded and shrub beds. Provide not less than the following quantities of specified amendments:
         - A-1 Organics Premium 3 soil amendment: 4 Cubic Yards/1000 SF
         - Commercial Fertilizer: (20-10-5): 10 lbs./1000 SF
         - Superphosphate: 10 lbs./1000 SF
   2. Seeding Application
      a. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage. Deliver seed to job site in the original unopened containers and submit the certified labels to the Landscape Architect.
      b. Mechanical Application: Seed by mechanical landscape type drills. Drill seed with approximately ½" inch of cover. Seed 50% in one direction and 50% at a 90 degree angle.
      c. Broadcast Application: Seed by broadcast method only when areas are inaccessible to drilling equipment.
   3. Erosion Control Netting
      a. Coordinate timing of soil preparation, fine grading and seeding on steep slopes and other locations subject to erosion such as swales with installation of erosion

control netting (blanket). Netting should be installed after all finish landscape work of this section is complete. Netting will not be installed in areas to be sodded. Netting will remain in place until grass is established. See civil drawings for erosion control netting requirements.

b. Maintain erosion control measures by repairing and replacing until Final Acceptance.

4. Extent of Bluegrass Sod shall be limited to athletic fields that can not be converted to synthetic turf. Other lawn areas should be seeded with drought tolerant grasses and provided with permanent irrigation.
5. Excavation for Trees and Shrubs
   a. Planting Pits: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Roughen sides of planting pit.
   b. Balled and Burlapped Trees: Excavate approximately 2 times as wide as ball diameter. The depth of the plant pit shall be 2 inches less than the depth of the ball in well drained soils and 4 inches less than the ball depth in poorly drained soils.
   c. Container-Grown Shrubs: Excavate approximately 2 times as wide as ball diameter. The depth of all plant pits shall be 1 inch less than depth of ball.
   d. Where drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.
   e. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavation.
   f. Drainage: Notify Owner's Representative if subsoil conditions evidence water seepage or retention in tree or shrub pits.
      - Fill all tree pits with water and allow it to completely drain before planting occurs.
      - If water does not drain out of pit within 24 hours, notify Owner's Representative.
      - All tree pits that fail to drain within 24 hours shall be mitigated at no additional cost to the Owner. Mitigation shall consist of over excavation of the pit and installation of a gravel sump with drain pipe as shown on the drawing detail.
6. Tree and Shrub Guying and Staking
   a. Upright Staking and Tying: Stake trees of 2- through 5- inch (50 through 125 mm) caliper and Evergreen trees up to 8 foot height. Stake trees of less than 2 inch (50 mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1800 mm) above grade. Set vertical stakes and space to avoid penetrating balls or root masses. Support trees with 2 strands of tie wire fed through white PVC pipe and tree collar grommets. Allow enough slack to avoid rigid restraint of tree. Twist ends of wire and trim off excess.
   b. Guying and Staking: Guy and stake evergreen trees exceeding 8 feet and deciduous trees more than 5 inch caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 48 inches long, driven into ground. Stakes shall be 12" above grade with approved plastic safety caps. Feed guy wire through white PVC pipe to hose chafing guard.
   c. Cover all exposed steel stake ends with approved protective plastic caps.
   d. Remove tree stakes and guys at the end of the warranty period as directed by the Owner's Representative
7. Tree Wrapping
   a. Wrap trees with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branch. Overlap wrap, exposing half the width, and securely attach

without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping.

b. No tree shall be wrapped after May 21 nor before November 1.
c. All deciduous trees shall be wrapped by November 15. Remove tree wrap by May 15.
d. Contractor shall be responsible for wrapping and unwrapping trees during the warranty period.

8. Plant Selection
   a. Landscape plantings should be selected for drought tolerance (xeric) and should not be palatable to wildlife.

PART 2 - PRODUCTS

A. Plant Materials
   1. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z 60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, girdling, and defects such as sun scald, injuries, abrasions and disfigurement.
   2. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z 60.1 for types of trees and shrubs required. Trees and shrubs of any larger size may be used if acceptable to Landscape Architect with a proportionate increase in size of roots and balls.
   3. Label each plant with securely attached waterproof tag bearing legible designations of botanical and common name.
   4. Label at least one (1) plant each variety and caliper with a securely attached waterproof tag bearing legible designation of botanical and common name.
   5. All plants shall be the species designated on the Drawings. No substitutions will be accepted without the prior written approval of the Landscape Architect. Contractor must provide proof of non-availability.

B. Trees
   1. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z 60.1 or type of trees required.
   2. Branching Height: ½ of tree height.
   3. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z 60.1, and stem form as designated on Drawings.
   4. Evergreen Trees: Specimen XXX quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, conforming to ANSI Z 60.1.
   5. Provide balled and burlapped trees.
   6. All deciduous trees of one species used in formal rows or groupings shall exhibit cultural uniformity, i.e. "matched" in height, crown width and shape, height to first branch, and trunk taper. For this reason it is desired that these trees be produced by a single grower.

C. Shrubs
   1. Form and Size:
      a. Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z 60.1 for type, shape, and height of shrub. Root development shall be sufficient to hold soil in the shape of the container when removed, but without visible circling roots.

b. Normal quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z 60.1.

2. Provide container-grown shrubs.

D. Grass Materials

1. Grass Seed: Fresh, clean, dry, new crop seed complying with the Association of Official Seed Analysts "Rules for Testing Seeds" for purity and germination tolerances.
2. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity and germination as indicated:
   a. Low Grow Mix - Sown over all irrigated native seed areas. Distributed by Arkansas Valley Seeds at (303) 320-7500.

Species	% P.L.S./Acre
Ephraim Crested Wheatgrass	30%
Dwarf Perennial Ryegrass	25%
SR3200 Blue Fescue	20%
Reubens Canada Bluegrass	15%
Chewings Fescue	10%
TOTAL	100%

   b. City of Aurora Mix – Sown over all non-irrigated reclamation seed areas
   See City of Aurora erosion control requirements for approved seeding mix and application rates.
   c. Pro-Sports Turf Mix – Sown over all athletic fields not sodded. Distributed by Arkansas Valley Seeds at (303) 320-7500.

Species	% P.L.S./Acre
Odyssey Kentucky Bluegrass (Midnight Type)	25%
SR2100 Kentucky Bluegrass (Shamrock Type)	25%
SR4600 Perennial Ryegrass	25%
Manhattan 4 Perennial Ryegrass	25%
TOTAL	100%

   d. Seeding Rate:
   40 lbs. per acre irrigated areas
   20-25 lbs. Per acre in non irrigated areas
3. Quantity of bulk seed required to provide the specified PLS shall be calculated from purity and germination percentage rates listed on the lot tag of seed actually purchased, using the following formulas:
   a. Purity % multiplied by Germination % = PLS %
   b. Lbs. PLS specified/1000 sf = Bulk Lbs., req./1000 sf PLS%
4. Sod: Certified turfgrass sod complying with ASPA specifications for machine-cut thickness, size, strength, moisture content, mowed height, and free of weeds and undesirable native grasses. Provide viable sod of uniform density, color and texture of at least 3 improved varieties of bluegrass and perennial rye, strongly rooted, and capable of vigorous growth and development when planted.
   a. Sod at general areas shall be GVT 2000 Kentucky Bluegrass Blend, as supplied by Green Valley Turf Co., Littleton, Colorado 303-798-6764 or approved equal.
   b. Sod at athletic field area shall be GVT Sports Kentucky Bluegrass Blend #1, as supplied by Green Valley Turf Co., Littleton, Colorado 303-798-6764 or approved equal.
   c. Sod which has dried out, or with soil which breaks, tears, or crumbles away will not be accepted. Sod shall be kept moist, protected from the sun, heat or wind, in

transport and after delivery. Prior to cutting, the sod shall be evenly mowed for a blade length of at least 1 inch but not more than 2 inches.

d. Sod for sports fields and large areas shall be ordered in big rolls.

E. Soil Amendments

1. Compost: Organic material for soil preparation shall be a mixture of 100% Premium 3 Compost and shall be free from subsoil, stones, and plants or their roots, sticks, weed stolons and seeds, high salt contents and other materials harmful to plant life. The Compost shall be coarsely ground and thoroughly mixed together to ensure an even composition. The mix shall meet the following mechanical analysis:

	Passing %	Retained %
2-inch screen	100%	0
1-inch screen	90 - 100	0 - 10
1/2-inch screen	50 - 80	20 - 50
No. 100 mesh sieve	0 - 15	85 – 100

2. Upon the request of the Landscape Architect, the Contractor shall provide test results showing mixture composition and analysis.
3. Compost: Shall be Premium 3 Compost, as produced by A-1 Organics, (800) 776-1644 or approved equal.

F. Planting Pit Backfill

1. Planting Pit Backfill: Soil backfill for planting pits shall consist of the following mixture:
   a. One part A-1 Organics Premium 3 soil amendment.
   b. Four parts native soil from pit excavation.
   c. Materials to be thoroughly blended.

G. Fertilizer

1. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
2. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
   a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency. Cost of fertilizer will be paid on a direct time and materials basis.
3. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency. Cost of fertilizer will be paid on a direct time and materials basis.

H. Mulches

1. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing for tree planting pits in sod and seed areas only, consisting of one of the following:
   a. Type: Fir Fiber Mulch as supplied by Front Range Materials, Arvada, Colorado, 303-425-9992

2. Fiber Mulch (hydromulch): Biodegradable green dyed-wood cellulose-fiber mulch, nontoxic, free of plant growth- or germination-inhibitors, with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
    a. Non-asphaltic Tackifier: Organic derivative vegetative gum tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth- or germination-inhibitors.
3. Rock Mulch: Hard, durable stone, washed free of loam, sand, clay and other foreign substances, of following type, size range, and color:
    a. Type: ¾" diameter crushed mountain granite, natural color range of greys, browns and reds as supplied by Front Range Materials, Arvada, Colorado, 303-425-9992

I. Weed Control Barriers
1. Non-woven Fabric: Spunbound Polyester fabric, 3.7 oz per sq. yd., minimum permeability of 160 gal. Per min. ft./2; Polyspun XL supplied by Direct Landscape Supply, Englewood, Colorado, 303-781-2270, or an approved equal.

J. Stakes and Guys
1. Upright Stakes: Green 8 foot x 2 inch diameter wolmanized lodge pole pine.
2. Guy and Tie Wires: 12 gauge galvanized wire. All guy and tie wires shall be covered with inch diameter PVC pipe, white.
3. Tree Collar Strap: Minimum 2 inch wide non-stretch webbing with grommets for attachment of wire between strap and stake.
4. Evergreen trees that are 8 feet tall or taller shall have wire guys threaded through rubber hose sections which are looped around the tree trunk and secured to 30 inch long metal tee posts. Fabric tree collar strap will not be acceptable on evergreen trees taller than 8 feet.

K. Landscape Edging
1. Steel Edging: Ryerson steel edging, 4 inch depth, 3/16 inch thick, with line stakes and splicer stakes as recommended by manufacturer.

L. Miscellaneous Materials
1. Antidesicant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed and fully labeled containers and mix according to manufacturer's instructions.
2. Pre-Emergent Herbicide: Treflan as manufactured by Elanco Company, or an approved substitution.
3. Trunk-Wrap Tape: Two (2) layers of crinkled paper cemented together with bituminous material, 4 inches (102 mm) wide minimum, with stretch factor of 33 percent.
4. Herbicides and Pesticides: EPA registered and approved, of type recommended by manufacturer.

DIVISION 33
UTILITIES

SECTION #	SECTION NAME	COMMENTS/CHANGES	DATE

331100 – UTILITY SERVICES

PART 1 – GENERAL

A. Summary - Section includes:

1. Water distribution/fire lines, fire hydrants, meter pits, and accessories 5' outside of building.
2. Sanitary sewage lines, manholes, cleanouts, and accessories 5' outside of building.

B. Referenced Standards:

1. For PVC pipe, conformance with C-900.
2. For DIP pipe, conformance with C-151.
3. Rules, regulations, standards and specifications of the applicable local municipality or water and sanitation district:

    a. East Cherry Creek Valley Water and Sanitation District
    b. Holly Hills Water and Sanitation
    c. City of Aurora (Water and Sewer)
    d. Arapahoe County Water/Wastewater Authority
    e. Chaparral Metropolitan District
    f. Cherry Creek Valley Water and Sanitation District
    g. Cherry Creek Village Water District
    h. City of Englewood (Sewer)
    i. Denver Water
    j. Gold Smith Gulch (Sewer)
    k. Havana Water and Sanitation (Sewer)
    l. Willows Water District (Water)

C. Submittals Required:

1. Product data.
2. Contractor shall transmit copies of inspection reports from Water and Sanitation District or Municipality to Owner and Architect.

D. Restrictions/Critical Criteria:

1. Coordinate design of water systems (domestic and irrigation) with the School District to reduce, where possible, the cost of tap fees.
2. Avoid sanitary sewage lift stations to the extent possible.

PART 2 – PRODUCTS

A. All materials/systems shall conform to the referenced specifications.

334100 – STORM DRAINAGE

PART 1 – GENERAL

A. Summary - Section includes:

1. Storm drainage
2. Ponds/outlet structures

B. Referenced Standards/Minimum Criteria:

1. Rules, regulations, standards and specifications of the applicable Storm Sewer District, Municipality or Arapahoe County.
2. Design shall follow the CCSD Stormwater Management Plan.

C. Submittals Required:

1. Drainage studies by the Civil Engineer for the local jurisdiction.
2. Product data by Contractor.

D. Restrictions/Critical Criteria:

1. Storm water shall not discharge over pedestrian walks, pipe underground where possible.
2. Design grades around buildings to achieve positive drainage away from building (prefer minimum of 2% slope around building.)
3. Protect inlet and outlet structures with tamper resistant screen to prevent passage of objects larger than 6 inches.
4. All day lighted pipes shall have concrete headwalls.
5. Permanent pond water will not be allowed.
6. Fencing around detention basins is not necessary except as required around outlet structures.
7. Storage and reuse of storm water for irrigation systems is not allowed by the State of Colorado except by special permit.

PART 2 – PRODUCTS

A. All materials/systems shall conform to the references standards.
B. All storm inlet grates shall be stamped with universal fish symbol indicating no dumping/water enters natural drainage way.

334600 – SUBDRAINAGE SYSTEMS

PART 1 – GENERAL

A. Summary - Section includes:

1. Gravel and drainage pipe around foundation and underslab drainage pipe.

2. Protective filler fabric.
3. Foundation drainage mat.
4. Cleanouts.

B. Referenced Standards/Minimum Criteria:

1. Unperforated PVC pipe: ASTM C2779.
2. Perforated PVC pipe: ASTM D2729.

C. Submittals Required:

1. Product data.

D. Restrictions/Critical Criteria:

1. Include subdrain system when recommended by Geotechnical Engineer.
2. Geotechnical Engineer, employed by School District, will observe layout, excavation and installation of subdrain system.
3. Include grade cleanouts at each major change of direction of pipe. In planting areas pour 12" x 12" concrete pad around cleanout.
4. Slope of drain and location of pipe to foundation per recommendation of Geotechnical Engineer. Use perforated pipe adjacent to foundations and unperforated elsewhere. All perforated pipe to be enclosed with ¾" washed gravel and gravel to be isolated from adjacent soil with one layer of Mirafi filter fabric.
5. Changes in direction of drain shall be made with 1/8 bends and Y fittings shall be used at all intersections.

PART 2 – PRODUCTS

A. Unperforated Pipe: Rigid polyvinyl chloride sewer pipe and solvent welded fittings.

B. Perforated Pipe: Perforated rigid polyvinyl chloride leaching system piping and solvent welded fittings. Provide solid end caps at terminations.

C. Cleanout pipe and fittings shall be of cast-iron soil pipe. Each cleanout shall have a brass ferrule and cast-brass screw jointed plug with socket for wrench.

D. Bedding around drain pipe: Washed 3/4" to No. 4 aggregate with less than 3% passing the No. 200 sieve.

E. Foundation drainage mat:

1. Mirafi Miradrain 6000.
2. American Wick Drain, Amerdrain 200